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LORD LISTER

BY

SIR RICKMAN JOHN GODLEE, Bt.

K.C.V.O., M.S., F.R.C.S.

"If we had nothing but pecuniary rewards and worldly honours to look to, our profession would not be one to be desired. But in its practice you will find it to be attended with peculiar privileges; second to none in intense interest and pure pleasures. It is our proud office to tend the fleshly tabernacle of the immortal spirit, and our path, if rightly followed, will be guided by unfettered truth and love unfeigned. In the pursuit of this noble and holy calling I wish you all God-speed."

Graduation Address, 1876

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TO

MY WIFE

IN THANKFUL RECOGNITION OF INVALUABLE HELP

KINDLY SEARCHING CRITICISM AND

TIMELY ENCOURAGEMENT

PREFACE

In writing the life of Lord Lister I suffer from certain disadvantages, which are counterbalanced—perhaps outweighed—by special advantages.

The greatest of the former is that I am his nephew and lived for many years in close personal contact with him. He watched over my career with almost paternal care, directed my studies and helped me in a thousand ways. Throughout the time of his active practice in London I assisted him in operations, and was entrusted with a large part of the care of his private patients. His scientific work was a constant subject of conversation between us. Such an intimate relationship is not good for a biographer. It obscures the true sense of proportion. Details of mere personal interest are apt to fill his pages, dwarfing the larger matters of public concern.

Another difficulty, never absent from my mind, and often raising a doubt whether it had been right to undertake the task at all, was that Lister had expressed the hope, not indeed in so many words to myself but in conversation with others, that the biography, which he saw to be inevitable, might be a simple record of what he had done for Science and for Surgery. But this was out of the question, for he was a public benefactor, and the world has a right to know something of the inner life of one who achieved so much on its behalf.

Nevertheless this restriction has prevented me from making a full use of the extensive correspondence between

him and his father, in which thoughts and reflections far too private for publication are often so closely interwoven with the story of his discoveries, that many letters of great interest have necessarily been rejected.

His life, which was not marked by many striking incidents, had to be recorded for at least two classes of readers: for those who are chiefly interested in him as a man, and for his professional brethren who need a full account of the course and development of his life's work. I also fondly think of the student of future days, who, perchance, may set some value on an authoritative statement by a contemporary of the reception that was accorded to Lister during his lifetime.

Medical and scientific men will, I hope, care to have most of that which is set out in these pages; but there is much that can hardly repay the close attention of the general reader. I have however tried to clothe these more abstruse matters in simple and intelligible language, and, as far as possible, have given some indication when sections are reached which may be skipped without losing the thread of the story. If the *Collected Papers* had been obtainable in some less cumbrous form than the large and expensive two-volume edition, much of the purely technical matter would have been omitted.

My qualifications for recording Lister's life are of the same kind as the disqualifications. I was just passing out of boyhood when he made his great discovery, and was old enough to have some faint inkling of its meaning. During my studentship I was able to compare the old system of surgery, then in full swing at University College Hospital, with Lister's practice in Edinburgh. Few are left who had so good an opportunity of making this comparison, or of watching the whole course of the modern revolution in surgery, or of noting the heresies and schisms as they crept in. Moreover I have access to his notebooks, many a page of which

I wrote to his dictation when, for a time, I was an almost daily witness of what was taking place in his laboratory.

Such then is my explanation: perhaps it would be better to say apology.

I have received much help from many of Lister's friends and from friends of my own. It is impossible to thank them all. But two deserve special recognition: Sir Hector Cameron, who has supplied invaluable information with regard to the birth of the antiseptic system in the early Glasgow days; and Stephen Paget, my wise mentor, who has read every page, who has exercised his sound judgment on scientific questions, and whose refined literary taste has pointed out some of the pitfalls that beset the steps of amateur authors.

R. J. GODLEE.

19 WIMPOLE STREET,
LONDON, W.,
September, 1917.

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I DESIRE to thank Mr. Emery Walker for the great trouble he has taken with all the illustrations, and especially for his strikingly successful photogravures. R. J. G.

CHAPTER I

PARENTAGE. CHILDHOOD. SCHOOLDAYS (1827-1844)

ENQUIRERS into the influences of heredity will want to know something about the stock from which Lord Lister came.

There were many of the name near Bingley in Yorkshire at the end of the sixteenth century, evidently in comfortable circumstances, and occupied in various trades.

In 1705 Thomas Lister, maltster and farmer, married Hannah Lister, the daughter of a yeoman. They both joined the Society of Friends, and their descendants have for the most part, till quite recently, been Quakers ever since. Their eldest son, Joseph, left Yorkshire about 1720, and became a tobacconist in Aldersgate Street. His youngest son, John, Lord Lister's grandfather, was born in 1737. He was apprenticed to a watchmaker, and followed that trade on his own account in *Bell Alley*, Lombard Street, from 1759 to 1766. He then took over his father's business, but gave it up in 1769 in order to acquire that of his father-in-law, Stephen Jackson, a wine merchant in Lothbury. The firm flourishes in the city to this day.

John Lister was a citizen of London, and a freeman of the Bakers' Company.[1] He lived to the age of ninety-eight. He had two daughters born within three years of his marriage and then, after an interval of nineteen years, in 1786, an only

[1] Extract from the Books of the Bakers' Company: "4th February 1760. This day John Lister, son of Joseph Lister of London, Tobacconist, who was bound apprentice to Isaac Rogers, Citizen and Baker, on the 4th of December 1752 was admitted to the freedom by servitude." Isaac Rogers was the watchmaker to whom he had been apprenticed in another sense in 1753.

son, Joseph Jackson Lister, of whom we shall have much to say.

This only son, born as it were out of due time, was a source of pride and anxiety to his parents and sisters. He was at three different Quaker schools between the ages of five and a half and fourteen, where he received a good education and profited by it exceedingly. His father was insistent upon his acquiring a knowledge of French and Latin, and shows in his letters that he speaks from personal experience of the advantages of these studies, which he does not wish to be pushed aside by such an "entertaining" subject as drawing.

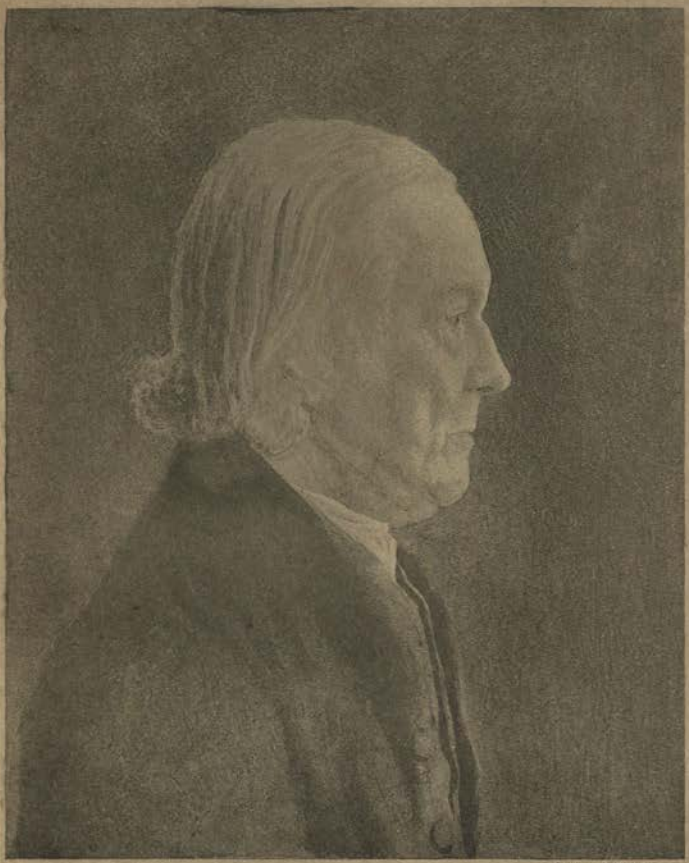
When he was fifty-nine years old, John Lister wrote thus to his little son of ten, who, at the tender age of seven, had been able to write a very respectable letter in French with "only two words corrected by the usher," and was already an excellent calligraphist.

"21st of 3rd month 1796.

DEAR JOSEPH,

As I often think of thee with desires that thou may grow up a sober industrious Lad, so am also desirous that thou shouldst see a little of what is publishing for th' instruction and benefit of the youth of the present Generation and adapted to the capacities and employments of many of them, have therefore sent thee 9 Books for the purpose, and I greatly desire that thy principal care may be to discharge thy duty to thy teachers, and to keep a conscience void of Offence, to thy Creator from whose bounty we are supplied with every favor that we enjoy. But on enquiring after thee from J. Vully the Usher, I hear that he has to complain of thy being so very long in writing about 10 Lines in a Copy, and learning a little spelling, that 2½ hours are often taken up therewith, which am satisfied thou mightst easily accomplish in one hour, so that thou hast but little time for the Latin, this has made me sorry, because an hour and a half wasted is a loss thou may have great reason to regret, as well as such a habit continued in of idling thy time must prove of bad consequence and deprive of the satisfaction of reflecting that thou hast spent thy time to the best of thy Capacity, which is both thy duty and interest.

Thy Usher therefore with me concludes that the writing and spelling shall be the last, that the prime of the morning may be applied to Latin and French, and I do desire thee to be in earnest whilst in the School to apply with industry, that so by overcoming the difficulties thou may begin to taste the sweets of Learning. The



John Lister
aged 78. 1mo. 1816
from a drawing by Joseph Jackson Lister

Usher desiring to borrow for thy perusal L'Henriade occasions me with sorrow to acquaint thee, that thy Cousin J. R. Stevens (whose Book it is) by giving way to a slothful disposition in a morning, not accommodating himself to our meals, and indeed by wasting time, has render'd himself so uncomfortable in my Family, that I did not chuse to keep him any longer; and he now lodges in an obscure Chandler's Shop, but desire thou wilt keep this information a secret, as we hope he may mend.

O my Son there is nothing like doing the best thou can to please those who have the care of thy instruction and thy good at heart, so hoping I shall hear no more complaints of thee, I remain with love, joined by thy Mother and Sister

Thy truly affectionate Father,

JOHN LISTER.

P.S. I think I have not been 1/2 an hour writing this tho' often interrupted and hope a word to the wise will be sufficient.

We intended to have sent thee a plumb cake, had we heard a better account but shall now leave it till another time."

Another letter of John Lister's has been preserved, dated 14th of 8th Mo. 1798, when his son was at school at Rochester.

" Being some days since returned from my Journey to Ackworth, thought it would be agreeable to send thee a few Lines, and first that I acquiesce in paying th'additional Sum on acco^{t} of the fewness of the Scholars who now learn drawing, but am with thy dear Mother desirous that thy attention to this entertaining part of thy education may not prevent thy improvement in the more useful branches thereof, and having been told by an acquaintance of your Teacher that thou art in want of Clark's Latin Grammar we have made general search for it but cannot find it, if such a Book therefore be wanting must request thy Master to procure it, as expect it will afford him some little profit to supply it, and still be no dearer to me.

Except from the closeness of the weather, and the burthen of a great Coat in travelling I had an agreeable Journey, much pleased with the order of the School, the Situation and Conveniences, which attend Ackworth, beyond many places; but think it must be bleak and very cold in Winter: thou resides in a South land, and hast many privileges beyond the bulk of poor Lads there, mayst thou be careful to prize them, and manifest thy grateful sense of greater favors by a prudent sober and orderly deportment, indeed I have a hope this will be thy endeavour, that so thou may be in the way of an eye being opened in the things that are more excellent."

On leaving school, Joseph Jackson Lister was apprenticed to the wine business in Lothbury, which was rapidly becoming

a prosperous concern, and at the age of twenty-two he was able to write to his father, who was travelling, that he felt fully equal alone " to the present routine of business."

Amongst the journeys about England which his occupation necessitated, he went occasionally, as his father had done, to the annual inspection of Ackworth school, sometimes in company with his friends Samuel and Joseph John Gurney, and it was here that he met his future wife.

Ackworth school, near Pontefract, was intended for the education of Friends " not in affluent circumstances," in other words, for those " of the peasant class " of whom there were many in the eighteenth century. The building, which stood in 127 acres of land, was originally (1757) a branch of the Foundling Hospital. When the annual Parliamentary grant was discontinued, the Hospital was offered for sale and was purchased by Friends for the sum of £7000 through the energy and business capacity of Dr. John Fothergill, who was himself a Quaker.

Joseph Jackson Lister's first visit to the school was in 1814. In the course of a glowing description of the interest and pleasure which it aroused, he said, " I was pretty well satisfied with the boys on the whole, but do not like their reading at all. I was admitted through the brother of one of the mistresses to hear five of the girls, and was delighted at the difference, for they read excellently, indeed the girls I am altogether pleased with, and the whole establishment does the superintendent great credit."

This superintendent was Isabella Harris, a widowed lady with six children. Her youngest daughter, also named Isabella, then 22 years of age, who taught the girls reading and writing, is thus described in a history of the first hundred years of the school.[1]

" Whilst the temporary cloud rested on the fame of the reading on the boys' side, that of the girls was attaining its highest excellence under the guidance of its young reading mistress Isabella Harris, jun. Whilst the girls' department generally was being administered by this lady's mother in a manner which ever gave supreme satisfaction

[1] *A History of Ackworth School during its first Hundred Years*, by Henry Thompson. S. Harris & Co., 5 Bishopsgate Street Without. London, 1879. p. 133.

to the Committee, the daughter very kindly devoted herself to the work of tuition, becoming in 1813 the recognised authority in reading, and supplying the post of teacher in this department. As such, she attained a position which has become historic in the annals of the School. They who were privileged to listen to her reading have spoken of its grace and force, of its masterly rendering of her author's meaning, and of the delicacy of the reader's intonation and emphasis, as excellencies never approached in their experience and as affording an intellectual feast of the purest quality. The well-known influence, also, which she exercised by her gentle and graceful life over the girls, enhanced the wide-spread interest created by her reading, and it became the ambition of all cultivated visitors to Ackworth to gain an opportunity of being present when it was Isabella Harris's turn to read in public. Experienced elocutionists—Lindley Murray amongst the number—considered her reading of a very high order. She conducted this department for several years, 'winning golden opinions,' not only from the inmates of the house, to whom her daily life was ever a pleasant picture, but from a wide circle of parents who saw reflected in their children traits developed by her influence which they valued above all price. She left the School in 1818, when the Committee made her a handsome present, in token of their high appreciation of her work, and testified their sense of it by minuting their gratitude 'for her valuable exertions in endeavouring to instruct the children in the paths of virtue and religion, and to promote the peace and harmony of the family.'"

The reason for her leaving was that she had become engaged to be married to Joseph Jackson Lister.

After one of his later visits to Ackworth, he turned aside to see what *Bingley*, the home of his ancestors, was like, and, perhaps in somewhat sentimental mood, wrote thus to his father on 5th month 3rd, 1817:

"I have thought I could not address a letter to thee from a more interesting spot than this must be to thee, the birthplace of my grandfather and the point where in tracing back the line of our ancestors our information terminates. This consideration has excited in me a train of pleasing and melancholy musings how soon oblivion covers the memory of the race that has ceased to live, and except a few who have been made renowned by intellect, by action or by station all trace is lost that they had ever been, even to their immediate descendants, so I find it here."

He goes on to say that the only remains of the family at Bingley were an honest simple-hearted labouring man about

70 years of age, named Lawford, and an old widow Horner, whose maiden name was Garnet. They were both children of sisters of his grandfather. They did not remember their grandfather, who had been a considerable farmer and miller. Then he describes Bingley:

" I omitted to tell thee that I came here on a horse I have borrowed of Charles Harris of Bradford, and by this means I have had an opportunity of enjoying to the utmost this lovely country. Indeed, I think I have not seen many sweeter spots than about the neighbourhood of Bingley. The fine open winding valley with the hills that slope down to it on each side—covered with wood or intersected by hedge rows sometimes cultivated to the summit, in other parts topped with heath or with masses of rock, the rich meadows in the bottom with a river winding through them and where the growth of the trees shows the luxuriousness of the soil. Altogether it forms, I think, a specimen of the most beautiful character of the country occupied by the coal formation. The moorlands on the hill tops are dreary, as I experienced yesterday in riding over to Addingham when I lost my way upon them, and I found the inhabitants of some lonely houses that are scattered here and there over them as wild as they, and speaking an indistinct jargon that I could not comprehend. The children here wear clogs, and make a droll clatter as they run along the street which reminds me of Keswick, but the sandstone houses here have not the cheerful appearance of the whitened limestone buildings of Westmoreland."

It is thus clear that the Bingley Listers lived in the very depths of the country, and were not " renowned by intellect, by action or by station." The usual paternal family tree is preserved with a few isolated facts which are useless in seeking for indications of hereditary genius. Possibly the first spark prompted Joseph Lister in the early part of the eighteenth century to seek his fortunes in London. If he had not done so, it may be supposed his descendants, if any, would have resembled the humble residue at Bingley after two generations had passed away. It is interesting to speculate upon the question whether it was the influence of London alone that made his son a well-educated merchant, his grandson an accomplished scientific man, and his great-grandson a genius, or how much of this advance may have depended on maternal influences. On this head there is little to be said. All that can be added is that the Harrises came from the Allendale

UPTON HOUSE

After a drawing by Mary Lister

ward in Cumberland about the lower reaches of the Derwent, and that for three generations they had traded to and fro with Ireland. Lister's grandfather, Anthony Harris, a master mariner of Maryport, was in good esteem amongst Friends, a strong opponent of negro slavery and one of the earliest pledged teetotalers. His wife, whose maiden name was Bull, was a native of Dublin. Her marriage, at the age of twenty-one, it is said, "did not at first abate her natural love of gay company." But after her husband was drowned at sea, leaving her with six young children and in expectation of a seventh, she became a prominent member of the Quaker community.

Joseph Jackson Lister after his marriage lived for three years at Tokenhouse Yard, where his business was carried on; afterwards for four years at Stoke Newington, and then bought Upton House, a capacious old Queen Anne house with fields and garden, at Upton in Essex. It was here in the following year on the 5th of April, 1827, that his fourth child and second son, Joseph, was born.

It needs an effort of the imagination to appreciate that Upton, now a dismal wilderness of workmen's dwellings and small shops, not even anywhere near the edge of Greater London, was at this time a country village. In truth, it was hardly even a village, but rather a winding lane which led from the Romford Road towards Plaistow, along which were scattered less than a dozen comfortable houses backing on grass lands or tilled fields. The Eastern Counties Railway was not constructed till 1839,[1] and those whose callings took them to London went on horseback, or drove, or took the coach or omnibus which passed through in the morning, summoning its fares with a horn. An idea of the rusticity of the neighbourhood may be gathered from the fact that this very year a red deer was run down in the garden of Upton House, and that flocks of golden plover were for long afterwards

[1] "Opening of the Eastern Counties Railway. 18th June, 1839. The Trains will start from the Temporary Station, Devonshire Street, Mile End Turnpike Gate, at One o'Clock, and proceed leisurely along the Line to Romford, where after remaining an hour for the Company to partake of Refreshments they will return to London." *Great Eastern Railway Magazine*, June, 1839, p. 179.

constant winter visitors to the neighbourhood. Hainault Forest was not far distant, and Epping Forest, close at hand, was at least as unfrequented as Savernake at the present day. The Barking marshes were a fine botanizing ground and the haunt of wild fowl, and it was a pleasant country walk along the banks of the Thames to London.

At this time the great city had hardly begun to stretch out its feelers to the east. So Upton retained its rural character well on into the sixties. The old house was a home of peace. Its master, writing in 1832, could say: "This is my first day in the country (at home) for a long time and it is by no means one of leisure, but I am writing in the study with the folding windows open to the garden; and the temperate warmth and stillness, and the chirping of birds and hum of insects, the bright lawn and aloe and the darker spread of the cedars and chequered sky above, altogether tempt to idle enjoyment that I must not indulge in."

Across the road, in front of the house, was a small patch of grass, bounded by a ha-ha with a low fence, providing a clear view into the extensive park of Ham House,[1] the home of Samuel Gurney, the banker of Lombard Street. It was on his advice that Upton House had been bought, and throughout their childhood and youth, the Lister family, ultimately consisting of four sons and three daughters, lived in close intimacy with the young people growing up at Ham House.

The circle of Friends who attended Plaistŏw meeting, twice on Sunday and once on Thursday—or as they would have said, First day and Fifth day—was large and interesting, including Elizabeth Fry, the well-known philanthropist, and numerous Barclays, Dimsdales and Shepherds. It was often joined by members of the family of Sir Thomas Fowell Buxton, which was closely related by marriage to that of the Gurneys. And besides this, the proximity of Plaistow to London attracted visits from many Friends from the provinces and foreign lands.

[1] Ham House was acquired by Dr. John Fothergill in 1762. The grounds contained many trees and shrubs imported from foreign lands, some of which found their way into the garden of Upton House.

It is difficult, if not impossible, to convey, in a few words, an idea of what may be called the Quaker atmosphere in the first half of the nineteenth century, which, owing to the dropping of peculiarities and the breaking down of barriers, can no longer be said to exist. As Friends refused, on conscientious grounds, to take an oath or subscribe to the thirty-nine articles, they were shut out from the old Universities and were therefore less likely than others to adopt the legal profession, and, though not to the same extent, that of medicine. They were, of course, absolutely debarred from taking orders, and as they rigidly maintained their "Christian testimony against all war," they could not join the navy or the army. So most of them followed some business or trade, and, being methodical and frugal people, living without ostentation or display, and free from the temptation to indulge in expensive sports or pastimes, they often became well to do, as the names of many wealthy bankers and brewers testify. But the very fact that they protested against "vain sports and places of diversion," that strict Friends neither went to theatres, nor danced, nor hunted, and had no music of any kind in their houses, left them free to devote much of their time to education and the pursuit of science. Thus even amongst those in moderate circumstances, it was common to find an intellectual man of high scientific attainments serving behind his own counter.

It is not surprising therefore that, to a considerable extent, they kept themselves to themselves. But for this there were other reasons. First: marriage with anyone belonging to another denomination led to disownment; it was called "marrying out of the Society." This resulted in much intermarriage and a large number of Friends being related to one another. Secondly: they adopted a special costume, not that of George Fox, but one of a bygone fashion (far behind the fashion of the day) and therefore sufficiently conspicuous. For the men it consisted of a plain black, grey, or drab suit, the coat shaped like a court coat with a stuck-up collar. The necktie was white. The hat was broader-brimmed than that of the man of the world, and was not removed either in a place of worship or for salutation. The women dressed in simple garments of sober

hue, with a spotless folded kerchief round the neck and a patternless shawl on the shoulders. They wore a white muslin cap of special shape, and the well-known "coal-scuttle" bonnet. Lastly: Quakers used the "plain language" thee and thou—not only amongst themselves, but to others. They did not use the suffix "Esq." nor the prefix "Mr." It was "Friend Gurney" and "Friend Lister"—even "Friend Gurney" from the butler, if he happened to be "one of us."

There being no paid ministry and no liturgy of any kind at the meetings for worship, which not infrequently were conducted in absolute and, for some at least, oppressive silence for nearly an hour and a half, there came a time to many a young Quaker, at the impressionable time of life, when he or she was overshadowed by the awful apprehension of receiving a personal call to "appear in the ministry" by uttering a few words of exhortation or prayer. If it was felt and responded to, the first step was taken in a course which might lead to becoming an "acknowledged minister." And although this recognition of a special gift did not interfere in any way with the ordinary avocations of life, it had the effect, to some extent, of drawing that distinction which in other denominations exists between the clergy and the laity.

Attendance at meetings for worship was thought to be essential, and scarcely less so was that at the business meetings, called "Meetings for Discipline," which were held monthly, quarterly and yearly, the last being a sort of annual parliament for the whole kingdom which assembled in London for a session of more than a week.

The affairs of the Society loomed very large in the minds of old and young, and it was common and apparently quite natural for the holding of meetings, the names of the speakers, and even the subject of their addresses, to be mentioned and commented on in schoolboy letters to parents or sisters.

It was perhaps natural for the youthful Quaker to look upon himself as one of the elect, until he found as he grew up that he was of like passions with the rest of mankind, and then the distinctive peculiarities, especially the "plain language," and what was lightly called "the livery," were apt to become intolerably irksome.

Such then was the atmosphere in which Lister spent his childhood and youth. It was neither dismal nor unwholesome. His family was a lively and a human one, free from sanctimoniousness and thoroughly enjoying their existence. They had their rides, their games of cricket and bowls, skating in winter and merry evening parties with their neighbours. But most of their recreations would perhaps in these days be thought rather dull: long country walks, the pursuit of natural history, the collection of fossils and so forth, and, whether at work or play, there was never any question that life was a gift to be employed for the honour of God and the benefit of one's neighbour.

The father of this happy family was in many respects a remarkable man. Although he left school at the age of fourteen and went at once into business, he gained a world-wide reputation for his discoveries in the field of optics, which led to the production of the "achromatic lens" and the perfection of the modern microscope. To a great extent he was self-taught. Between the years 1824 and 1843, whilst actively engaged in business, he found time to make his mathematical calculations, actually to grind the glasses himself, and to supply the necessary data to Tulley, Ross and Smith, who were the manufacturers. This work gained for him the Fellowship of the Royal Society in 1832, and brought him into contact with a large scientific circle, amongst whom were Bowerbank, Airey, Herschel, Sir Richard Owen and Dr. Hodgkin, with the last of whom he wrote sundry papers describing microscopic observations, the most interesting of which dealt with the then unsettled question of the true shape of the red corpuscles of the blood.[1]

Amongst the documents possessed by his son, and recently presented to the Royal Microscopical Society, is a paper written in 1842-3, "On the Limit to Defining Power, in Vision with the Unassisted Eye, the Telescope and the Microscope." For some reason it was never published, probably because some part of the work had previously been done by

[1] Hodgkin, Thomas, and J. J. Lister, "Notice of some Microscopic Observations of the Blood and Animal Tissues," *Phil. Mag.* 1827, vol. ii. pp. 130-138.

Frauenhofer. It contains a number of elaborate observations and abstruse calculations anticipating many of the discoveries which have since been made by Abbé and others, and now, after the lapse of seventy years, it has been at last given to the world.[1]

In 1846, after the death of his eldest son John, a young man of quite exceptional ability, he seems to have given up his optical investigations, and the circle of scientific men who used to meet at Upton to discuss these matters was gradually broken up.

But though his main interest may have been science, it was by no means his only taste, for he was a good Latin scholar, and had a sound knowledge of French and German. Whilst at Tokenhouse Yard, he and some of his friends still living in the old-fashioned way over their business houses in the City, used to meet for lessons given by a French *émigré*. He shared with the same group of men in many of the philanthropic interests which were a striking feature of the early part of the nineteenth century.

His powerful mind, clearness of thought, mathematical accuracy and natural humility exerted a great influence upon his son, an influence which in public and private was frequently acknowledged. As the children grew older, they used to read Latin authors—and not the simplest—with their father while he was dressing. He was an excellent artist. His delicate landscape drawings, some made with the *camera lucida*, bear comparison with those of the better known water-colour artists of the time; and that he was equally successful with portraits is shown by the accompanying reproduction of a pencil sketch of his wife, whose grave and beautiful face rightly suggests that she was not only a loving mother, but a wise guide and counsellor in times of perplexity.

Joseph Lister went to two private schools: the first was at Hitchin and the second was Grove House, Tottenham. He was forward for his age, especially in classics, but his letters show that his interests and amusements were those of the

[1] *Journal of the Royal Microscopical Society*. 1913. Part 1. pp. 34-55.

Isabella Lister

from a drawing by Joseph Jackson Lister

ordinary schoolboy. In 1839, when he was twelve years old, his master reported, "He finds no difficulty in his learning, and I hope is making good progress. I have to report favourably of his conduct. He is full of spirits, which sometimes cause him to overstep the rules of order and bring him a little into disgrace."

When he went to Tottenham he was surprised to find himself placed amongst the top boys. His mother wrote, "What a high standing Joe takes at Tottenham (dear fellow, I want much to see him), it tells well for his own diligence, and for his old school, too, to be so forward in the classics: I hope it will not elate him too much." At Tottenham a first-class all-round education was provided. Little time was wasted on Latin verses, but the boys read as much of the classics as they would have done at most public schools, and were well grounded in mathematics, natural science, and modern languages.

They were also made to write essays in which great attention was paid to grammar and composition. The subjects were no doubt usually set by the master, but the pupils were apparently allowed to deal with them in their own way. More than thirty of Lister's efforts are preserved, each covering four quarto pages. These were written when he was fifteen or sixteen years old, and are caricatures of the exact and somewhat formal style of his later writings. All manner of thorny questions are discussed and settled to his boyish satisfaction. But the most interesting are four dealing with "The Human Structure—Osteology" and one on "The Similarity of Structure between a Monkey and a Man," illustrated by beautiful pen and wash drawings. The material is, of course, chiefly taken from books, but it is clear that before leaving school he had a fair knowledge of the human bones, and some acquaintance with comparative anatomy. Amongst the essays is included a lecture—a regular schoolboy's lecture—on Chemistry, "delivered at Grove House School 5th Mo. 18th 1843," in which, being in search for references to medicine, we note the almost loving way in which he deals with the properties of laughing-gas.

At an early age he began to macerate bones, dissect fish

and small animals, and to articulate their skeletons. At the age of fourteen he wrote to his father from Upton during his holidays, " I got almost all the meat off; and I think all the brains out of the sheep's head and then put it into the macerating tub," and a few days later, " As this is the last day I shall be here for some time, I thought I must just write a short note to thee to tell thee how I spent my time when Mamma was out, and also after she came home. When Mamma was out I was by myself and had nothing to do but draw skeletons, so I finished the cranium and named the bones of it, and also drew and painted the bones of the front and back of the hand, and named them. Mamma came home on seventh day, at about 2 o'clock, and in the evening, with John's help, I managed to put up a whole skeleton, that of a frog, and it looks just as if it was going to take a leap, and I stole one of Mary's pieces of wood out of one of the drawers of the cabinet in the museum, to stick it down upon, and put it on the top of the cabinet with a small bell glass over it, and it looks rather nice. Do not tell Mary about the piece of wood."

But long before this, when quite a child, he had announced that when he grew up he would be a surgeon. It was entirely a spontaneous wish. None of his relations, except a distant cousin, were doctors. No Lister had ever dreamt of embarking in a professional career of any kind. His father, though highly approving of his taste for natural history, at first rather discouraged the idea of surgery as a pursuit, his instinctive feeling being rather, as he said, " to let Nature do her own work." But as his son's bent became more pronounced, no obstacle was put in the way, and it became recognised in the family that Joseph was to be a surgeon.

LISTER AGED 13 YEARS

SILHOUETTE BY HIS FATHER

CHAPTER II

UNIVERSITY COLLEGE, LONDON, AND UNIVERSITY COLLEGE HOSPITAL. EARLY PHYSIOLOGICAL WORK (1844-1853)

LISTER left school in the spring of 1844 at the age of seventeen and was sent to University College, London, which, in spite of certain cloudy seasons, had hardly passed the period of its initial success. It was somewhat ostentatiously non-sectarian, and the only resort for those who were debarred from entering the older seats of learning on account of the religious tests which they imposed. It was a place essentially for work, and not for amusement, and it possessed a hospital which, though long since pulled down as obsolete, was, for that time, modern and well equipped.

The first three years at College were occupied in passing the Matriculation of the University of London and in taking the degree of B.A. Such a preparation for the medical career his father thought essential; and Lister himself always recommended it to young men entering the profession if time and money could be spared. This was not the happiest time of his life. He worked very hard in rather gloomy surroundings. Then he had an attack of small-pox, after which he returned too soon to his studies and embarked upon them with redoubled energy. The result was a serious nervous breakdown which necessitated a long holiday in the early part of 1848.

Whilst he was travelling in Ireland and the depression had almost passed away, his father wrote him the following wise and sympathetic letter:

"UPTON. 7 mo. 1. 1848.

MY DEAR JOSEPH,

In thinking of you as engaged in what promises to be an agreeable and beneficial excursion for you all, I can hardly forbear expressing to thee the pleasure with which I look back to our cheerful parting, in connexion with the very interesting and tender interview thou hadst with thy dear mother and me before it. I have compared it to the sunshine after a refreshing shower, following a time of cloud —and I trust the remembrance of our conversation may be permitted to dispel from thy thoughts, some phantoms of the dark—that thou wilt become fully aware of what is certainly true—viz. that the things that sometimes distress thee are really only the result of illness, following too close study—and also that it is *indeed* a mistake proceeding *from the same cause*, to believe thyself required to bear burthens on account of the states of others, while in fact thou hast to suspend even the pursuit of thy own proper avocations. And believe us, my tenderly beloved son, that thy proper part now is to cherish a pious cheerful spirit, open to see and to enjoy the bounties and the beauties spread around us :—not to give way to turning thy thoughts upon thyself nor even at present to dwell long on serious things. Thou wilt remember how strongly Dr. Hodgkin cautioned thee on these points, as dangerous to thy mental as well as bodily health. . . .

Do not consider thyself required to answer this which contains some things I should not generally advert to."

After this refreshing time, his preliminary medical studies began in earnest in the winter session of 1848, under the guidance of teachers of considerable eminence. Lindley was Professor of Botany, Graham of Chemistry, and Grant of Comparative Anatomy. George Viner Ellis, the very soul of exactitude, taught Anatomy, and W. B. Carpenter, Medical Jurisprudence. Lister learned more of the preliminary sciences, including physics, than the average medical student, and in a far more practical manner. His precise and rather laborious way of acquiring knowledge, and his remarkably accurate memory made this knowledge a life-long acquisition. He often spoke of Lindley and Graham ; but amongst all these men of science who watched over his earlier years, Wharton Jones and Sharpey apparently exercised the greatest influence.

Wharton Jones, at this time about forty years of age, was Professor of Ophthalmic Medicine and Surgery at University College. He was once publicly spoken of by Jenner as one

of the greatest Englishmen who ever lived, and he received very high praise from Huxley on the method and quality of his physiological teaching. His small stature, peculiar manners, outrageously Scotch accent and modest and retiring disposition, limited his circle of friends, and combined to deprive him of his due meed of praise; but he was undoubtedly one of the foremost physiological discoverers of his day. He was also a successful, if not a brilliant ophthalmic surgeon, a philosopher and a man of wide culture. His output of work was large and covered an extensive field. Particular mention may be made of his investigations on the circulation of the blood and the phenomena of inflammation, because they were carried out on the frog's web and the bat's wing, and no doubt suggested to Lister this method of research, which he afterwards followed with such fruitful results. Wharton Jones was not his official instructor in physiology. It was, so to say, an accidental occurrence that Lister became associated with the physiological studies of the Professor of Ophthalmology.

William Sharpey, the Professor of Physiology, was a very different man. He was a few years older than Wharton Jones, and has been called the father of modern physiology, because he was the first to give a special course of lectures on this subject, which, before his time, had been treated as an appanage of anatomy. After completing his medical course in Edinburgh, he went to Paris to study clinical surgery under Dupuytren, and operative surgery under Lisfranc, and there began his close and life-long friendship with the great Edinburgh surgeon, Syme. He trudged with his knapsack through France, Switzerland, Italy and Austria, and then settled in Edinburgh, where he taught anatomy with Dr. Allen Thomson as his physiological colleague. What modern physiologist would dream of spending so long in perfecting himself in medicine and surgery before settling down to teach his own specialty? He left Edinburgh in 1836 in order to become the first Professor of Physiology at University College. There he was beloved by the students because he lectured so simply and so clearly, and because he took such a warm interest in their welfare. His great influence at the Royal

Society, exercised over many years, was not without its advantages for his young friends. Part of every summer he spent with Syme, and he kept in close touch with Allen Thomson; these three were the presiding geniuses over Lister's early career.

At the present day the medical curriculum is divided into what have been called water-tight compartments. Students learn nothing of medicine or surgery until they have finished with the preliminary sciences. But it was not so at the time of which we are speaking. Then it was the custom for them to go round the wards and pick up what they could in the intervals of attending the dissecting room or working in the chemical laboratory. They therefore became acquainted with the hospital staff at the very beginning of their studentship.

The staff of University College Hospital included many well-known physicians and surgeons. Amongst them were Walshe, Jenner,[1] and Erichsen.[2] Lister served as house physician to Walshe, and afterwards, in 1851, as house surgeon to Erichsen. His house surgeoncy, by good fortune, extended to nine, instead of six months, owing to the resignation of Watkin Williams, who gave up medicine for the law and afterwards was raised to the bench. Erichsen was not a great surgeon in the sense of being a breaker of new ground, or a specially skilful operator, but he was a careful observer and a man of sound judgment and wide knowledge. He had a large private practice and was a shrewd man of the world. His well-known book, *The Science and Art of Surgery*, held the field as the most popular text-book on the subject for many years. It was a useful discipline to serve under him, though it cannot be said that he was altogether an inspiring teacher.

Lister began to study surgery very shortly after the discovery of anaesthetics. As a freshman he was present at the first operation performed under ether by Robert Liston at University College Hospital in December, 1846. The introduction of anaesthesia is, as everyone knows, a landmark

[1] Afterwards Sir William Jenner.

[2] Afterwards Sir John Erichsen.

in the history of surgery, but the change that it wrought was a gradual one. It did not give rise to any sudden advance in practice. No striking new operations were immediately introduced, no new fields were opened up for a time. In spite of the fact that there was no longer the same urgent need for haste, operations were still performed with breathless speed; indeed the idea that the more quickly the process could be completed the better for the patient, lingered on for another quarter of a century. Students in the fifties, therefore, saw precisely the surgery of the pre-anaesthetic days, robbed only of its most shocking feature—the pain inflicted by every operation. There was a plentiful display of manual dexterity; but, looked at as a whole, it was rough and ready surgery. At University College Hospital one theatre of modest dimensions, containing one small instrument cupboard, a sturdy wooden table, a single gas jet and a solitary washing basin, served for every purpose, including the novel one of administering the anaesthetic. Here most of the surgical staff assembled every Wednesday to watch the three seniors operate. They performed in order of seniority, and with such celerity that one afternoon was usually enough for all the operations of the week, except those of emergency. There was nothing, however, in what he saw in the operating theatre, beyond its intense interest, to attract the attention of the student. He knew it was a good sample of London surgery, and had no reason to criticize it. But, when he followed up his cases in the wards, there was much to make him think, much to make surgery a sad calling for a beginner. It seemed to be a lottery whether patients recovered or died; and, if they recovered, whether convalescence should be smooth, or retarded by inflammations and suppurations, erysipelas or gangrene. He could not understand how his teachers had the hardihood to use the knife except under the most urgent necessity. Operations of mere expediency were indeed looked askance at; they were spoken of as "tempting Providence," and a special ill luck was supposed to accompany them. But they were occasionally done for all that, and it was dreadful to see a healthy person passing through a period of great peril or even losing his life in consequence of some trivial operation

that might have been avoided, and strange to think that it was considered justifiable to expose patients to risks which they could not appreciate, and that no one was to blame if it ended in disaster.

Amidst such surroundings Lister had his first introduction to surgery, and its sadder side made a deep impression upon him. But there is little or no reference to this in his letters. Medical students have not much time, as a rule, for letter-writing, and are not apt to indulge in moralizing. Lister's, at this time of his life, are the merest scraps, and, if any mention is made of surgery at all, it is to narrate some particularly interesting or exciting case he had to treat or that had come under his notice. This again is the common experience. Very quickly the interest of the work engrosses the attention, and forces the dismal aspect of surgery—for even now it has its sad side—into the background.

Up to the time when he obtained his first resident appointment in the hospital, he had been living with three or four others under the tutelage of an older man, also a student at the College, a member of the Society of Friends of somewhat austere religious views. Under this not very wholesome influence, he lost for a time the brightness of his boyhood and became a very serious young man indeed. He has been described by a cousin some years his junior, one of his fellow lodgers, as " kind and considerate, but rather dwelling apart and not making any strong friendships with his fellow students." But the solemn man with whom they lived spoke of him as one " who in the total excels anyone I know, or have known, in bright promise for the future."

It was a wholesome change from this stifling existence to the pleasant club-life of a hospital resident. There for the first time he came into really close contact with young men of other denominations, educated perhaps at public schools, who had imbibed broader views from parents and teachers moving in the great world. Amongst his fellow students were many who afterwards became distinguished: Sir Watkin Williams, the judge; Sir Henry Thompson, who was house surgeon when Lister was dresser; Sir William Roberts, his life-long friend; Sir George Buchanan, of the

Local Government Board; Sir William Flower, of the Royal College of Surgeons and South Kensington; and Sampson Gamgee and Hillier, less known to fame, while Sir Alfred Garrod barely preceded him, and Wilson Fox was hardly his junior. Lister entered with zest into the exciting student politics which were training these budding geniuses for their life's work. He figured largely at the Debating Society, and took a very active part in the affairs of the hospital Medical Society. Here he headed a sharp attack on the homœopaths —not the last of such efforts on his part—which was followed by long and stormy discussions. He also read papers before the Society which showed the direction of his thoughts; one was on hospital gangrene and one on the use of the microscope in medicine. The latter led to much difference of opinion, some holding that the employment of the microscope would sound the death knell of accurate clinical observation.

Gold medals and distinctions at the College and the University were then highly prized, and there was keen rivalry between the various medical schools. Lister became one of the champions who were trusted to maintain the reputation of University College, and he fully justified the confidence of his fellow students. Sampson Gamgee wrote to him on August 30th, 1850: "As a student of University College I am grateful to you for having sustained the honour of the school, after such a critical session as that of 1849-50. Had it not been for you, University College would have been a nonentity at the examinations for honours at the University, whereas it now stands second school in London, placing Guy's first and St. George's third."

The deadly earnest with which these honours were contested, and the interest which Lister also excited amongst his teachers, is shown in the following almost apologetic letter which he received from his examiner, Dr. W. B. Carpenter, then Professor of Medical Jurisprudence at University College, who had placed him last in the honours division at the physiological examination for the M.B. degree. It has a further interest as indicating the spirit of enquiry and doubt with which he began his studies of the scientific groundwork

of medicine, a spirit which required a satisfactory proof of the truth of even the most hallowed traditions.

"UNIVERSITY HALL Nov. 26th, 52.

DEAR SIR,

I fear that you will be much disappointed at finding yourself lowest upon the list for Honours, which I have to-day sent in to the University; and I think it as well to let you know the reason why I found it requisite to place you there. It was *not* because you expressed, on one or two points, opinions different from those which I have advocated; for I have, before now, recommended for the *Scholarship* gentlemen who have done this, with an independence which I am always glad to see; but because, *as answers to my questions*, your papers were so defective, that if it had not been for the amount of original observation of which they bore evidence, I could not have placed you in the honours list at all. Whether this defect was the result of a want of systematic knowledge, or the consequence of the injudicious employment of your time—much having been spent by you in disquisitions which I did not require,—I have no positive means of knowing; but I fear that the former must be partly the case, since you were obviously very imperfectly informed upon the second question of the afternoon paper (which was answered very correctly by every other gentleman)—although you had the opportunity of hearing me go fully into the subject in my course of Medical Jurisprudence last spring.

Should you wish to know more of your deficiencies (I do not recollect any absolute error) I shall be glad to tell you what I can (having returned the papers), if you will call on me here.—Believe me to be,

Yours sincerely,

WILL^M. B. CARPENTER."

With the acquisition of the M.B. of the University of London and the Fellowship of the Royal College of Surgeons in 1852, his long studentship of nine years at University College drew to a close. During the latter part of it he had done some remarkable original work which, if we are in search for the inspiration, may be said to be due to the influence of Wharton Jones and Sharpey, corroborated by that of his father.

The work was microscopical and experimental. The microscopical part resulted in two papers published in the *Quarterly Journal of Microscopical Science.*

The first[1] deals with observations made during 1852 regarding the muscular tissue of the iris (the coloured part of the eye). Professor Kölliker of Würzburg had been the first to show that this contractile curtain in front of the lens was made of involuntary muscular tissue. He had also proved that all involuntary muscular fibre was made up of cells. But his discoveries, though almost anticipated by Wharton Jones, were not then universally accepted. Bowman, for example, a rising young microscopist, of whom we shall hear later, was opposed to them. Lister, however, confirmed and extended Kölliker's observations, and for the first time demonstrated the existence of two distinct muscles in the iris, the dilator and the sphincter, for enlarging and diminishing the size of the pupil. The paper also contained some interesting original physiological observations on the functions of involuntary muscular fibre.

The second paper,[2] dated from University College Hospital, June 1st, 1853, is also a confirmation of some observations of Kölliker, in this case on the involuntary muscular fibres of the skin. These minute muscles elevate and depress the hairs, causing the familiar phenomena of "goose skin" and the bristling of a dog's crest on the approach of a suspected enemy. Lister added definiteness and accuracy to these observations by carrying them out upon the scalp, where the hair follicles are particularly large. The exact attachments of the little muscles to the skin and the hairs are beautifully demonstrated, and the paper, like that on the iris, is illustrated by delicate *camera lucida* drawings.

All these investigations were carried out before any of the modern improvements in section cutting, or hardening, or staining of tissues, were thought of. He thus describes his somewhat primitive procedure:

"In enumerating the parts where he has met with muscles connected with the hairs, Kölliker does not mention the scalp, probably because the density of the tissue of this part rendered it unfit for

[1] *Quarterly Journal of Microscopical Science*, 1853, vol. i. p. 8. *Collected Papers*, vol. i. p. 1.

[2] *Quarterly Journal of Microscopical Science*, 1853, vol. i. p. 262. *Collected Papers*, vol. i. p. 9.

investigation by the method in which he prepared his objects, viz., isolating a hair-follicle with its sebaceous glands and treating it with acetic acid. Its very firmness and consistence, however, make the scalp better adapted for fine sections than any other part of the skin; and as I succeeded better with sections than by any other method, the scalp has received most of my attention. By compressing a portion between two thin pieces of deal, and cutting off with a sharp razor fine shavings of the wood and scalp together, moderately thin slices may be obtained." Further on he says, "But I afterwards found that much better sections could be obtained from dried specimens. A portion of shaved scalp being placed between two thin slips of deal, a piece of string is tied round them so as to exercise a slight degree of compression; the preparation is now laid aside for about twenty-four hours, when it is found to have dried to an almost horny condition. It then adheres firmly by its lower surface to one of the slips, and thus it can be held securely, while extremely thin and equable sections are cut with great facility in any plane that may be desired. These sections, when moistened with a drop of water and treated with acetic acid, are as well suited for the investigation of the muscular tissue as if they had not been dried."

These two papers attracted a good deal of attention both at home and abroad. Sir Richard Owen, an old friend of his father's, thought he saw in Lister a recruit for his own special department of science, zoology, and in thanking him for a copy, wrote thus on August 2nd, 1853:

"Accept my thanks for the copy of your Memoir on the contractile tissue of the Iris, and of the later one just received on the muscles of the hair-follicles.

Both memoirs are of great interest, and to me, more particularly, as indicative of the future probable gain to anatomy of a careful and exact observer whose early love of that science I may have helped to foster. . . .

I can sympathise with your good father in the happiness which your Professional career must have afforded him."

Kölliker was naturally pleased at the support of the young English surgeon, for he had great sympathy with England and English institutions, and was a frequent visitor to this country. Lister often met him in after years, and his youthful admiration led to a life-long friendship. Near its close, in 1897, the old German professor, who was still lecturing at the

age of 80, wrote the following touching letter to his friend, who was then President of the Royal Society :

"WÜRZBURG, 17. Nov. 97.

MY DEAR LISTER !

I do not know, if in writing to the Secretary of the Royal Society, I expressed my thanks for the award of the Copley Medal in the right manner and if I should not have written to you, as President of the Royal Society. At all events I do it now, as I well know, that I owe the great honour conferred upon me, especially to your kindness.

Since the time, when my old friends Sharpey, Allen Thomson, Carpenter, Bowman, Huxley and many others died, I also seem to be forgotten and you, my dear Lister, Lubbock and James Paget are nearly the only ones of my friends of old times left. I hope that you will be so kind, to express also to your Council my best thanks and to add, that I am very sorry not to be able to attend your anniversary meeting to receive the medal from your hands, but on one side my duties as lecturer, and the more my age do not permit me to travel now and so I hope you will excuse me. I am now eighty years old, but no age will ever make me forget the happy days of yore, which I passed in Scotland in the society of Syme and your own at Millbank and on Loch Long.

Now my dear old young friend fare well. Remember me to Sir J. Paget and believe me always,

Your very affectionate,

A. KOELLIKER."

The first experimental, as opposed to merely microscopical work, that Lister is known to have done was also carried out in 1853, but the results were not published till four years later at the meeting of the British Association in Dublin.[1] The subject of the paper was the flow of the lacteal fluid in the mesentery of the mouse. The object of the experiments was two-fold—first to ascertain the character of the flow of the chyle (that is, the nutritive material extracted from the food) under ordinary circumstances, which he believed had never been satisfactorily made out; and secondly, to endeavour to throw some light upon the debated question whether the lacteals (the vessels which collect the chyle and conduct it to the veins) were capable of absorbing solid matter in the form of granules visible to the naked eye. His

[1] *Collected Papers*, vol. 1. p. 25. See p. 63.

method of procedure was to mix some colouring matter, usually indigo, with bread and milk, with which the animals experimented on were fed. The mesentery was drawn out of the abdomen and laid upon a plate of glass placed under the microscope. It was thus possible to settle both objects of his enquiry. The conclusions were that no rhythmical contraction took place in the lacteals, and that no indigo particles were ever seen in the chyle.

During his studentship there were many pleasant holidays besides the long one following upon his illness. These were spent, mostly with members of his own family, in various parts of England, Ireland and the continent. Elaborate diaries of them are preserved. His letters show that he was a diligent observer of geology and architecture, language, manners and customs, and that he had acquired more than a nodding acquaintance with French and German, besides a smattering of Dutch. Their style is rather stilted, and the matter not very interesting. One or two may be given as samples. He writes thus to his youngest sister, then seventeen years of age:

"HOTEL ROYAL HANOVER,
28th of 3rd mo. 1849.

I must write thee a few lines this evening, if it be only as an excuse for sending thee this pretty sheet of paper, which I bought this afternoon in the town. Thou wilt find it worth looking close at; the gable ends of the houses are very well shewn in it, and very striking they are; such a multitude of little windows, and so much ornament. Thou wilt see that one is the house of the famous Leibnitz, whose bust stands in one part of the town, under a cupola supported by pillars on stone steps. I must not go on further without giving you the reason of our being still at Hanover; it is because poor cousin Anthony is still suffering from asthma, though better than he has been." [Here follows a long description of a novel form of mustard plaster used by the German doctor. He continues,] "Though this illness of Cousin Anthony's is of course very trying for him, it gives *me* a good opportunity of seeing this interesting town. This morning I was standing looking at one of the gable ends before mentioned, with its curious carving, when a gentleman called to me, and began telling me that it was the oldest house in Hanover, and very curious, and then asked me whether I would like to see the King's horses, for we were near the palace of his Majesty the

Duke of Cumberland (our Queen's uncle as I daresay thou knowest). I said I should like it, so finding out without any difficulty that I was an Englishman he called an English groom who has lived seven years in Germany, and told him to show me the said horses. And noble animals the carriage horses were, fine 'Yorkshire greys' some or one of them, and all English. I could not get into the palace itself, as it has been lately closed against visitors since a disturbance made by either democrats or mob in the town. A market was being held, which made my walk through the town more interesting. I like making purchases in these continental towns, it lets one a little into the every-day life of the people. I have been in a good many shops to-day, and find that, thanks to Jno. J. Tiarks, &c., I can get on better than I might have expected in talking German. I had quite an interesting chat with a man of whom I bought a pair of India rubber braces, and who . . . had stuffed birds as well as saddlery in his shop. He has interesting birds, live as well as dead." [After a minute description of the *table d'hôte*, particularly dwelling upon the custom of bringing in a lighted candle before the coffee for the men to light their pipes by, he continues,] " As we were not a large company, and I as far as I know was the only English person there, I had an opportunity for taking a good German lesson, by listening to the conversation, trying to catch its sense and pronunciation."

In a letter written to his mother the following day from Hamburg, he says:

" This day has been occupied with the journey to this town. We started by train at 10 minutes before ten (or by London time at 5 minutes past nine) and journeyed by this conveyance as far as Haarburg through a very uninteresting flat plain, so sandy and sterile as fully to bear out the lines

' 1st George in 1713
From *barren* Hanover was seen.'

Indeed I never before saw anything like so large a tract of barrenness. Fir trees are planted however in some parts and seem to do well. We saw a large number of troops on their way to Hamburg, in two trains each containing 800 men! besides horses. However the landlord here thinks there will be no fighting, about the Schleswig-Holstein business. Just before we left Hanover a telegraphic despatch arrived announcing that the King of Prussia had been elected Emperor of Germany. I am afraid the Hanover people at least expect no great good from it, and it seems rather odd that he should be made Emperor when he cannot keep his own subjects in order; but we shall see. I dare say Chevalier Bunsen is not sorry."

These epistles recall his schoolboy essays; they are so precise and formal. It would almost be a relief to meet with some fault in punctuation or mistake in grammar. But there is a different ring in them when he is telling his father about some natural object he has observed or some microscopical investigation. Thus, writing from Shanklin, on August 20th, 1851, he says:

"I succeeded pretty well with the shrimps; by getting very small ones and looking at them with the $\frac{1}{8}$ glass in the trough I saw the peristaltic action of the intestinal canal, the heart beating very rapidly (about 400 times in a minute), the aorta pulsating at the same time, the rapid arterial currents in the limbs, but more interesting still to me the blood slowly returning over the surface of the limbs and over the back to the heart, its motion being indicated by the very distinct blood corpuscles. I even saw as I believe a valve in the middle of the upper part of the heart alternately open and close at each pulse. There were several other objects of great interest which I have not now time to allude to. We are very happy here.

I had a glorious bathe to-day and swam 52 yards in 2 minutes."

At the end of his studentship he had no definite plan for the future. For a short time the allurements of medicine seem to have been even stronger than those of surgery, but he soon returned to his first love. When the time came for leaving University College, Sharpey suggested that he should complete his studies by attending the practice of Syme in Edinburgh for a month, and then pay a longer visit to some of the continental schools. No doubt it was expected that, when all this had been accomplished, he would settle down in London: but this was not destined to take place till after the lapse of many years.

CHAPTER III

EDINBURGH. INTRODUCTION TO SYME. HOUSE SURGEONCY AT THE ROYAL INFIRMARY (1853-1855)

NINE years had now passed since leaving school: not all of them occupied in medical studies. Two had been devoted to obtaining the B.A. degree of the University of London, and there had been an interruption of some months owing to illness.

Lister was filled with anxiety at the thought of finding himself in the false position of a young consulting surgeon who might have no personal acquaintance with the obscure diseases, and only an imperfect knowledge of the more common cases which would be brought before him. He was still more apprehensive of the mischief which his want of experience might cause to his patients; and, in a less degree, of the effect which mistakes might have on his chance of success. Thus, though fully conscious that his education had extended over an unusually long period of time, and that the plunge into practice must, before long, be made, he was glad to follow Sharpey's advice to devote a month to a short visit to Edinburgh and a longer time to seeing something of the continental schools.

After a time of relaxation, which he described as "lazy," in Ireland, visiting the Dublin Exhibition and exploring Killarney and the west, we find him in September, 1853, settled in Edinburgh, having taken lodgings in South Frederick Street. He presented his introduction to Mr. Syme, who received him with open arms, at once invited him to dine, offered him the opportunity of assisting with private

operations, and promptly set him to work at the hospital. It seems to have been a case of mutual attraction from the very first, which grew into a life-long friendship, and led to quite unexpected developments in Lister's career.

It is not difficult to appreciate his frame of mind on realizing, probably for the first time, the activity and the importance of the Edinburgh school. Fresh from a prolonged studentship in the largest city in the world, where, then as now, it was too much the fashion for students to see nothing outside their own hospitals; proud as he no doubt was of University College and firmly convinced of its superiority over other schools; a Fellow of the Royal College of Surgeons, and loaded with University honours; it was a wholesome lesson for him to find that, in many ways, Edinburgh was far ahead of London, and to be brought into contact with Mr. Syme, who was generally acknowledged to be the most original and thoughtful surgeon in the country—many said in Europe—and one of the boldest, coolest and most successful operators of the day.

"The Infirmary," he says in a letter to his father, "is larger than I expected to find it; there are 200 *Surgical* beds, and a large number in other departments. At University College Hospital there were only about 60 Surgical beds, so altogether a prospect appears to be opening of a very profitable stay here"; and again, "Syme is, I suppose, the first of British surgeons, and to observe the practice and hear the conversation of such a man is of the greatest possible advantage"; and in the same letter, "If the day were twice as long I should have abundant occupation for it, and such an occupation as I believe will be valuable to me for life, if I like to practise surgery."

Syme was 54 years of age, in the full swing of surgical practice, both private and at the Infirmary, one of the most important members of the University, and a pioneer not only in the manner of teaching clinical surgery, but in the wider field of medical education in general. Though he often aroused fierce opposition, he was eminently one to inspire enthusiasm. He had many stout supporters and admirers, and Lister quickly became one of the most ardent of

these. Respect and admiration soon ripened into affection which was never overclouded. In this it was unlike some of Syme's friendships, which occasionally ended in stormy dissolution, for he could not brook opposition even from friends. He held strong opinions and was very outspoken in expressing them. He inherited not only his father's acuteness and sagacity, but—to adopt the words of his biographer, Dr. Paterson—"his perseverance and obstinacy," which led him to embark with zeal, and apparently with something of the joy of a warrior, upon medical polemics and disputes on many occasions,—controversies, for the most part entered into on behalf of principles, the matter of which was acknowledged usually to have been right, whatever may be said as to the manner in which they were conducted.

Students of the medical history of the first half of the nineteenth century cannot fail to be struck by the acrimony with which discussions were carried on, the amount of jealousy which they excited, and the personal element which was constantly introduced. There is scarcely an author who does not speak of the "odium medicum." It was a relic of the still more quarrelsome times of Mead, Jenner and the Hunters, and indeed had been handed down from the long past. Lister had none of this combative spirit, though he evidently felt that it was in the air; but, strange to say, he seems to have thought that it would more easily be avoided in Edinburgh than in London. "I shall not have, as in London," he said in a letter to his father, "to fight with jealous rivals, and contend or join ingloriously with quacks, but I shall be able, if all be well, to acquire a solid reputation in a legitimate manner, and then, if it seem desirable, move to London, and stand on my own ground there. I am by disposition very averse to quarrelling and contending with others, in fact, I doubt if I could do it though I have never tried much, but at the same time I do love honesty and independence, which without contention would be almost impossible in London."

Syme probably put this idea of London into Lister's head. Edinburgh had come to be looked upon almost as a recruiting

ground for London surgeons, or perhaps it should be said that London was considered to be the happy hunting ground for Edinburgh surgeons. Liston, Sir William Fergusson, and Sir Charles Bell had made their fortunes there, and Syme had followed that example in migrating south. For a short time in 1848, he had been Professor of Surgery at University College, but the atmosphere of the place was uncongenial. "I found," he said, "such a spirit of dispeace in the College as to forbid any reasonable prospect of comfort," and accordingly, before his successor had been appointed, he shook off the dust of London from his feet, and was glad to return to his native city.

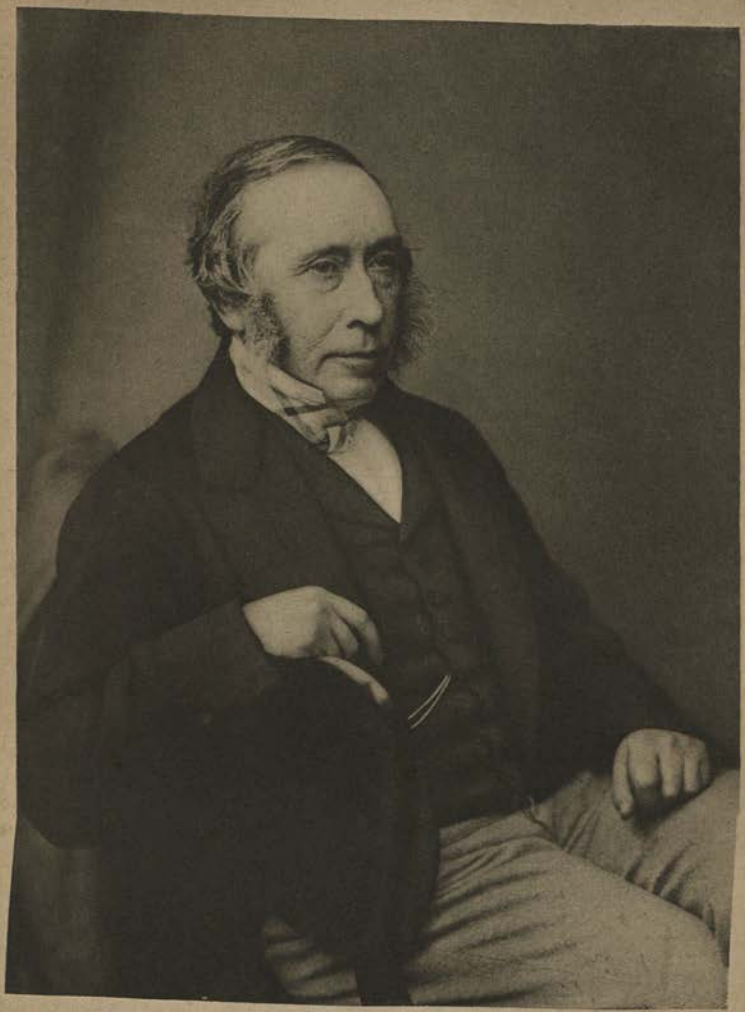
Syme was a great teacher. In his early days, when the Managers of the Infirmary had refused to appoint him to a vacancy in the surgical department, he boldly started a hospital and school of his own at Minto House, where he introduced his own special method of clinical instruction. This met with general approval, though some urged its inferiority to bedside teaching, which, however, it was not intended to supplant, but to supplement. It will here be described in his own words, because it was one which he followed for the rest of his life, and was adopted by Lister with marked success in his clinical lectures.

"The plan which I introduced into the Edinburgh school and which I still pursue, appears to me worthy of adoption. This is to bring the cases one by one into a room, where the students are comfortably seated, and if the patients have not been seen by the surgeon beforehand, so much the better; then, ascertaining the seat and nature of their complaints, he points out their distinctive characters.

Having done this so that everyone present knows the case under consideration, the teacher, either in presence or absence of the patient, according to circumstances, proceeds to explain the principles of treatment, with his reasons for choosing the method preferred; and lastly, does what is requisite in the presence of his pupils.

The great advantage of this system is, that it makes an impression at the same time on the eye and ear, which is known by experience to be more indelible than any other, and this conveys instruction of the most lasting character." [1]

[1] *Lancet*, 1864, ii. p. 391.



Emery Walker ph. sc.

James Syme
from a photograph

Syme's consulting rooms were in the city; but he had a charming house, Millbank, at Morningside, where he devoted his leisure to his garden and his orchids, and hospitably entertained his friends. The numerous foreign surgeons who visited his clinique were sure to be invited to dine there, and many lasting friendships were made with successive generations of house surgeons.

Lister became a frequent visitor at Millbank, and was thus brought into contact with a much wider circle than the restricted one in which he had moved in London. It was by no means confined to members of the medical profession. There were men of varied culture, not the least distinguished of whom, as it happened, were doctors. Such were Dr. John Brown, the author of *Rab and his Friends*, who was a familiar friend of the family, and Dr. (afterwards Sir Robert) Christison, the famous Professor of Medical Jurisprudence. One eminent man, Sir James Y. Simpson, celebrated as a gynaecologist, an archaeologist and the discoverer of chloroform, he probably did not meet at Millbank. The relations between Syme and Simpson oscillated between those of friendship and opposition. At this time they were not of the most cordial nature, and this did not tend to encourage familiarity between their followers and admirers.

Amongst the reasons for the success of the Edinburgh school, which had started on its career of increased activity towards the end of the eighteenth century, was the fact that all the University teaching was grouped around one centre. Successful University professors were thus inspired by having to address themselves to much larger classes of students than were then, or for the matter of that, are now, ever assembled at any of the London medical schools. This was a great stimulus; and there was another of perhaps equal potency. Teachers who held no official appointments were, if duly qualified and recognized by the University, permitted to hire lecture rooms and give independent courses, called "extra-mural" or "extra-academical," attendance on which was allowed to count instead of a part of the ordinary University lectures. This had a double advantage: first, that of keeping the University professors up to the mark; and secondly, that

of training the younger men, and providing a good selection of candidates, who had shown their capacity for teaching, whenever a University professorship fell vacant. The success of these classes was sometimes remarkable. In 1828-9 that of Mr. Syme, "who always thought that the teaching of systematic rather than clinical surgery was really his *forte*," contained no less than 250 pupils, though Liston, Lizars and Fergusson were all lecturing on surgery at the same time.

In these new surroundings the first month sped away all too quickly, and by the end of October, 1853, although Syme advised him to "hoist his flag pretty directly," Lister had made up his mind to spend at least the winter in Edinburgh. He was becoming daily more and more impressed with the advantages he was gaining there, and the thought of a continental tour in the near future had faded into the background.

He told his sister of this decision at the end of a letter containing a glowing account of his being rung up at five in the morning to go down to Dunblane to help Syme with a primary amputation at the shoulder joint, "Mr. Syme thinking it would amuse me." "I had the honour, or privilege of acting practically as the only Assistant, who on such an occasion is rather a responsible officer." Further on he says, "Syme has his own views based on great experience with a sound judgment and a very original mind. So that my present opportunities are teaching me what I could not learn from any books, nor indeed from anybody else, while my experience which our small hospital in Gower Street had left considerably limited is daily receiving important additions. I am therefore quite satisfied that it will be well for me, if all go well, to spend the winter here even though my doing so should make my visit to the continent exceedingly short."

A month later he was appointed Mr. Syme's "supernumerary clerk" or supernumerary house surgeon. It was a non-resident post, much sought after and usually held by one who had already served the office of dresser. The duties were to assist at every operation, hand instruments, sponges, etc., and generally to keep an eye on the cases and take notes without sharing the responsibility of the treatment. This, while

introducing him to the hospital work, did not prevent his being taken to private operations, and allowed him time to prepare a valuable short paper on the microscopical structure of a cancellous, or pedunculated, exostosis removed by Mr. Syme.[1] "I little thought," he says, "when I came here that I should read a paper before a full meeting of the Edinburgh Medico-Chirurgical Society, attended by some of the most eminent men of the present day; yet such has been the case." In it he demonstrated, probably for the first time, that the method of ossification of these growths was the same as that which occurs in the epiphyseal cartilage. But he did not apparently trace their origin to imperfection in the natural process of ossification.

At the close of this eventful year 1853 he wrote as if all the clouds had disappeared from his mind, and the sunshine were almost too bright to last.

"I have nothing particular to say about myself, except that the stream of surgical instruction and of Syme's kindness continues to flow steadily and, if possible, increasingly. If the love of surgery is a proof of a person's being adapted for it, then certainly I am fitted to be a surgeon: for thou canst hardly conceive what a high degree of enjoyment I am from day to day experiencing in this bloody and butcherly department of the healing art. I am more and more delighted with my profession, and sometimes almost question whether it is possible such a delightful pursuit can continue. My only wonder is that persons who really love Surgery for its own sake are rare."

On returning from a Christmas visit to Upton he was met with the information that Syme's resident house surgeon had been called away, and that he was expected to take his place. As a matter of fact, the absentee did not come back, and Lister took on the duties of the office which, owing to circumstances it is unnecessary to dwell upon, he was able to hold for more than a year, that is, till the end of February, 1855. In this he was exceptionally fortunate, Syme's house

[1] "Notes of the Examination of an Exostosis removed by Mr. Syme on October 2, 1853, from the Os Humeri of a Young Lady aged about Twenty Years." Read to the Edinburgh Medico-Chirurgical Society, Nov. 16th, 1853. Extracted from the *Monthly Journal of Medical Science*, vol. xviii. p. 7, 1854. *Collected Papers*, vol. i. p. 201.

surgeoncy being already engaged "three deep." It might have been thought beneath the dignity of a Fellow of the Royal College of Surgeons of England to take such an appointment; but Lister was amply rewarded. Syme gave him to understand that, in his case, he might consider that their mutual relations were those of surgeon and consulting surgeon. He seldom interfered with the treatment of ordinary cases, and allowed Lister the exceptional privilege of using his own discretion as to which of the cases admitted at night he should himself operate upon. His fellow-residents were pleasant and jovial companions, very keen about their work, but full of friendly chaff, which Lister by no means resented. He had twelve dressers—three times the usual number—for Syme could not resist urgent appeals for these appointments on behalf of the sons of his many friends. For dressers it is almost more important to serve under an experienced house surgeon who can and will teach them, than to be attached to the most distinguished surgeon. The twelve were not slow to appreciate their good fortune. They called Lister "the Chief": a term of affection and loyalty which clung to him amongst his disciples for the rest of his life. During this long period of a specially privileged house-surgeoncy, he had the opportunity of performing many operations before the students; amongst others he speaks of one on a cataract successfully removed "without trembling of the hand."

He was also busy with his pen: sending to the *Lancet* weekly summaries of Syme's lectures, which will be found in the pages of that journal between January and December, 1855; for he continued to supply these reports after his house surgeoncy was over, besides publishing some of Syme's cases in the *Monthly Journal of Medical Science*. He also conducted, in 1855, a lengthy and somewhat heated correspondence with Mr. W. Adams in defence of Syme's view with regard to the pathology of club-foot and allied diseases, and his method of treating them.[1] In this the views of the Master with regard to specialists in general and orthopædists in particular are clearly revealed, and cordially endorsed. This

[1] *Lancet*, 1855, vol. ii. pp. 204 and 447.

was Lister's one and only effort in controversy of this description. He gladly followed his father's wise advice: "I daresay it is a good answer to thy antagonist, though I have not seen his article—and I suppose he has given occasion for something of personality that I think I observe in thy tone, and which in public discussion it is in general desirable to avoid—but I shall be *glad* if the matter drops without further rejoinder and reply. It is easier to enter the lists than to leave them unscathed, and he for whom thou hast come forth as the champion is abundantly able to defend himself or to attack his foe. And is there not danger that in assailing a *class*, as I think thou dost, by implication at least (a class comprising men very various in attainments and character), thou mayst be making thyself enemies of strangers, besides consuming thy much occupied time?"

He became, indeed, so closely identified with Syme that there was some excuse for his father's playful suggestion in an earlier letter, "*nullius jurare in verba magistri*," and for a still earlier amusing letter from his friend and fellow student George Buchanan, written from University College Hospital, Dec. 10th, 1853:

"Edinburgh—Syme—Super house surgeon. Why! you must be in a perpetual state of bliss of the most aggravated description, operations being to you a foretaste of the joys prepared for the good. We saw your name in the papers as an adopted child of Syme's, reporting a case for him. I see you have swung back to Surgery with the greater vigour for your late apparent oscillation on the side of Physick. Become Syme's equal, if you will in Surgery, but pray don't catch his only too apparent egotism! If modesty is a character of true genius, Syme runs a chance of getting this latter denied him you must allow."

Lister justified himself to his father in a letter written from the Royal Infirmary, 1st mo. 24. 55, in which he says:

"I feel a peculiar interest and satisfaction in the work I am engaged in, promoting the publication of Syme's lectures: I am pleased to be a means of aiding in the diffusion of his many original views in Surgery, the result of an acute and comprehensive mind working upon an experience of upwards of thirty years. Had it not been for the publication of his lectures, much of his wisdom must have gone whenever he went himself. It is also a pleasure to feel

that I am really doing him some substantial service in return for his very great, and I must say disinterested, kindness to me. I find too that hitherto this work has had the effect of making me more than ever on free and comfortable terms with him, and the next thing to possessing experience oneself must be the having open access to that of another. The lectures, too, as I think I mentioned in a former note, are exceedingly instructive, embracing, much more than formerly, an account of the history of each subject more or less with a full description of the pros and cons of the treatment. At the same time I endeavour to bear in mind, and have done so all along, thy motto 'nullius addictus . . .', but I must say that the more I see of Syme the more I feel his value as a 'magister.' I am almost surprised to find how in every lecture, delivered on the cases that happen to be in the wards at the time, there are one or more subjects discussed, in which he holds more or less peculiar views, and those, so far as I can judge, sound ones. I wish thou couldst get the Lancet for this week: his lecture in it contains, besides another subject, his views on chloroform, and I think it would be interesting to thee to see how clearly he shows that fault in the manner of administering the chloroform is at the root of the occurrence of fatal cases in London, and that too in consequence of the neglect, more or less, of a few very simple principles. For my own part I have more and more confidence in the safety of this most valuable agent, when properly used, although from the London journals it would seem as if people there were becoming more and more afraid of it. It is a subject that a person not in the profession can well understand, and one that interests everybody, and that lecture would serve as a fair specimen of the kind of productions I get ready for the editor. As a general rule each number of the *Lancet* contains the most important subjects of two lectures, put together there as one lecture. Do not suppose that I am worked so hard as to be unable to get any recreation: yesterday afternoon I walked to the top of Arthur's Seat with Wilson Fox and one of my fellow residents; and to-day (Syme being about to go to the country so as not to visit the hospital) the same party mean to make an excursion to the top of the Pentland Hills, weather permitting."

During the whole of the year 1854, while Lister was happily and peacefully occupied as house surgeon in Edinburgh, our country was in the throes of the Crimean war. Many young surgeons volunteered for service with the forces; and amongst the letters that have been preserved are some from his friends giving graphic accounts of the hardships and experiences of that miserably mismanaged campaign.

One of these volunteers was Dr. Mackenzie, a man of great promise who had been formerly Syme's house surgeon and was at the time surgeon to the Infirmary and lecturer on surgery to the College of Surgeons. He was possessed of good talents, a great lover of his profession and a very brilliant operator. He was giving up general practice—had, indeed, changed the Dr. on his door-plate into Mr.—and it was generally understood that he would succeed Syme in the clinical professorship, the only permanent surgical appointment in Edinburgh, for the other surgeoncies were only held for a term of years and were often occupied by men engaged in general or even midwifery practice.

Mackenzie's real object appears to have been to secure the Professorship of Military Surgery; and he intended to be back by November, 1854, in order to deliver his winter course of lectures. But, after gaining great praise for his exertions and his brilliant operating after the battle of the Alma, he fell a victim to cholera, deeply regretted by the army among whom his benevolence had been conspicuous, and by the whole of Edinburgh who valued him very highly. The news of his death reached Edinburgh in October, 1854. Lister's contemporaries and friends at once suggested that he should continue Mackenzie's lectures and apply for the vacant assistant surgeoncy at the Infirmary. It needed, however, no prompting to consider the advisability of seizing this opportunity which chance had put in his way at the precise moment when he was ready to take advantage of it.

Nothing, of course, was to be done without consulting Syme, who at first threw cold water on the scheme. Further consideration, however, changed his opinion; and, when it became apparent that he was not only in favour of it, but prepared to do his best to open up and smooth the path that naturally led up to the Chair of Clinical Surgery—perhaps the most important surgical appointment in the three kingdoms—Lister, though almost overwhelmed with the prospect, quickly decided that it was right "to take advantage of this unrivalled opportunity."

He said nothing about this momentous question of settling in Edinburgh to his father for four months, not indeed until

he had quite made up his mind. He then wrote a very long letter, of twenty quarto pages, in which he excuses his silence by saying that when, in the autumn, Syme had advised him to pursue his original plan of settling in London, neither he nor his friend Beddoe were satisfied that he was correct in his judgment; but they both decided that to do anything in the matter without Syme's approbation would be madness, and therefore he had not thought it worth while to disturb his parents' minds by any allusion to the subject.

In this letter he explained the whole situation, and the special advantages he would enjoy from Syme's promise of general support and of allowing him free access to his wards. He went on to speak of Syme's success, but added:

"It does not however at all follow that I should have a tithe of that success in either department. Still if a man is not to take advantage of the opportunities that present themselves to him, what is he to do, or what is he good for? This is the principle I have always gone upon in taking advantage of opportunities that have offered for doing operations myself: though at first I have sometimes been almost ready to shrink from them, yet I have braced myself up with that kind of reflection that if I do not do this now how shall I be fit to do my duty as a surgeon hereafter, and then when I *have* undertaken such operations, as it were on principle, I have always got through them to my own satisfaction or even pleasure.

A poor man came in last 5th day with his hand shockingly mangled; I had a great deal to do of other things and I really felt little disposed to endeavour to patch up the contused, lacerated and misshapen mass: however I undertook it: it required as much exercise of judgment as I ever was called on to use in Surgery to determine how much to sacrifice, and at last I felt some hesitation when it was over whether I had taken away enough. However I felt a satisfaction in having done my best for him that few but a surgeon I imagine can feel, and he has since gone on favourably: and the thumb and forefinger which I left will I have no doubt have their full power eventually; and it is his *left* hand.

This however is an episode, though meant as an illustration of the principle I am speaking of. The question now is should I not take advantage of this unrivalled opportunity of advancing in my profession? It is true it must depend entirely on myself (under the blessing, if I may humbly say so, of Almighty God in Christ Jesus) whether I succeed or not; but I am encouraged to hope that though I must not expect to be a Liston or Syme still I

shall get on. Certain it is I love surgery more and more, and this is one great point; and I believe my judgment is pretty sound, which is another most important point. Also I trust I am honest and a lover of truth, which is perhaps as important as anything. As to *brilliant* talent I know I do not possess it: but I must try to make up as far as I can by perseverance."

There really was "*only* one feeling on the other side,"—that Edinburgh was so far from home; and the conclusion of the whole matter was that, the more he thought of it, the more convinced he was that it would be right for him to go forward, and, if so, that no time should be lost in securing the lecture room to prevent its being taken by another.

Without any delay he hired the coveted room at 4 High School Yard. On April 21st he was elected a Fellow of the Royal College of Surgeons of Edinburgh, and two days later he took lodgings at 3 Rutland Street, a convenient position opposite Syme's consulting room; and the business of preparing for the lectures was now set about in earnest.

In June he paid a short visit to Paris; partly in order to see something of the surgical practice there, but chiefly with the object of performing operations on the dead body. Here his time was busily employed. He rose at 7; visited one of the hospitals from 8 to 10; breakfasted; made notes of what he had seen till 12; operated from 12 to 2.30 or 3; the rest of the day being devoted to correspondence, exercise and reflection. In July he was back in Rutland Street, the continental visit having been reduced to one month, the precise time originally intended to be devoted to Edinburgh!

Four months only remained before the opening of the winter session, but there were many things to distract his mind from the formidable task before him. One, the most distracting of all, was enough to keep his thoughts fully occupied. Little has been said about the family circle at Millbank; but it may be gathered from casual remarks in his letters and still more from letters passing between his parents, that from early days there had been a mutual attraction between him and Syme's eldest daughter Agnes. By the end of July he could think of nothing else, and said he might as well be at Upton, almost, as regarded preparation for

his lectures. The matter was accordingly put to the test and his suit was accepted, after which he returned to his work with redoubled energy and a peaceful mind.

In those days, when a Quaker married one of another denomination, it led almost invariably either to resignation of membership or to disownment. In such a seriously-minded family as Lister's, this was naturally a cause of considerable regret. After some heart-searching, his mind was at last clearly made up. He decided to resign his membership, and before long he " ceased to wear the appearance of a Friend," and ordered his first door-plate with " Mr. Lister " upon it. If he had not severed his connection with the Society the inscription would have been plain " Joseph Lister." Later he became a member of the Episcopalian Church. In this communion he found peace and satisfaction, holding, as he did, the opinion ably expressed in an Epistle of the Society of Friends published the year before, that " true religion stands neither in forms nor in the formal absence of forms."

Lister would have wished that little stress should be laid on matters such as these, for he seldom spoke of them except to his nearest friends, and he hoped that his biography, if ever written, would deal chiefly, if not altogether, with his scientific work. But it is necessary to explain to some extent the influences by which he was surrounded in the early part of his career. They were influences which governed the whole of his life, though from this time forward he remained in the fullest sympathy with the church of his adoption.

Emery Walker ph. sc.

Joseph Lister
aged about 28
from a daguerreotype

CHAPTER IV

"THE EARLY STAGES OF INFLAMMATION." EXTRA MURAL LECTURES. MARRIAGE AND WEDDING JOURNEY (1855-1856)

LISTER was now established in his Rutland Street lodgings, helping Syme with his operations, seeing, vicariously, private patients and enjoying the experience of making his first fee, for treating a case of dislocation backwards of the ankle, which he reduced while the patient was under the influence of chloroform.

In a letter, dated September 16th, 1855, which records this event, he also described the beginning of by far the most important of his early investigations. This was on the "Early Stages of Inflammation." The letter is interesting in itself, and gives a characteristic picture of him at his work.

"I have now only six weeks more before my introductory lecture! and everybody almost is asking me if I am nearly prepared." After referring to the natural distractions of a Benedict, he continues, "But I am now really doing work: I have long wished to see the process of inflammation in the frog's foot, and, as I think I once told thee, felt that the early stages of that process had not been traced as they might be, so as to see the transition from a state of healthy increased redness to inflammation. Accordingly, having for some weeks past been getting together the necessary apparatus, and having got a frog from Duddingstone Loch (which you saw from the Queen's drive on 5th day week) I proceeded last evening to the investigation. Mr. Sparshott, the most intelligent of the last set of dressers, and who is to attend my lectures in the winter, kindly assisted me, and a most glorious night I had of it.

I had the frog so placed and fixed that I could inject anything upon the web under the microscope from a syringe, and it so happened that the frog was not only perfectly healthy, but with remarkably little pigment, and exceedingly quiet. By using a ⅔ object-glass I had a fine large field of view, and had under observation always the same artery, with the field of capillaries into which it divided and the two veins which returned the blood from them: and thus was able to watch with great precision the effects produced: the animal rarely struggling at all.

I first threw on water of about 80°, which had the effect of causing the artery to contract to obliteration of calibre almost for a few seconds, while the flow of blood in the capillaries ceased; then followed a dilatation to a little above the natural calibre while the flow of blood was *greater* than natural, and after a few seconds more the natural calibre was resumed: the warm water having previously flowed away from the web. Then I threw on successively hotter and hotter water, with the same effect except that the subsequent dilatation was greater when the temperature was hotter, till at last I used water of nearly 200° and pretty long continued:—the effect of this was a degree of dilatation of the artery *far* greater than ever before (about 2 or 3 times its natural calibre) and at first an enormously increased flow of blood: the capillary network becoming far more red than natural, and each capillary coming to admit 3 or 4 blood corpuscles abreast instead of only one as is seen in the figure; but this could not go on for long, for the capillaries became distended and stuffed with the red corpuscles, and the blood was first retarded, then stagnant. Thus with the simplest of stimulants, *heat*, I traced the process of inflammation from the beginning in I believe a more satisfactory way than it has ever been traced before. I often uttered involuntary exclamations of delight during the time. I cannot of course give thee (without making *much* too long this already too long letter) a full account of the numerous very interesting facts that turned up in the course of the evening: suffice it to say that the experiments were all successful (about 12 altogether of them) and all told one uniform tale, exploding completely the false theories of two or three authorities and confirming and adding to the correct theories of some, though no one has, I believe, hitherto told the tale just as it ought to be told. And this result was got by the very simplest possible experiments neatly executed. I am half inclined to give my opening lecture on inflammation: but I shall see in a few days.

To tell the truth this successful investigation of last night has much improved my spirits, and I really look forward with something less like despair than I have done for some weeks past to my lectures. Mr. Syme says by way of encouragement that

after the first plunge I shall get on well enough. This is I know making the best of a baddish job, but I hope there will be some truth in it."

It is anticipating events, but it will prevent confusion if we now shortly describe a series of papers, more or less closely linked together, and all bearing on the question of the early stages of inflammation, so graphically referred to in this letter. The observations on which they were founded were continued till 1858. They were the product of much thought and work during the period he had just passed through and the more important time which was approaching. They doubtless influenced the character of his lectures, which, although they were supposed to treat of systematic surgery, usually ended—so it was said—in some pathological or physiological disquisition.

The first of this series of papers was read before the Royal Society of Edinburgh on December 1st, 1856. Its title was, "On the Minute Structure of Involuntary Muscular Fibre." [1]

Like his earliest publications, it dealt with purely histological matters. It again confirmed and extended some observations of Kölliker, and it contradicted those of Ellis and others who had doubted the conclusions of the celebrated Würzburg physiologist. It proved conclusively that, in the arteries of the frog, and in the intestine of the pig, the involuntary muscular tissue is composed of slightly flattened elongated elements (cells), each provided, at its central and thickest part, with a single cylindrical nucleus embedded in its substance. It further showed the marvellous degree of extension and contraction of which these muscle cells are capable. Thus, in full extension, they are very long fibres with rod-shaped nuclei, and in full contraction almost globular masses with oval nuclei. And, lastly, it pointed out the extraordinary range of contractility which characterizes the hollow viscera. These beautiful and important observations failed to attract the general attention of histologists, as may be gathered from the following letter from Dr. Th. W. Engelmann,

[1] *Trans. Roy. Soc. Edin.* (1857), vol. xxi. p. 549. *Collected Papers*, vol. i. p. 15.

written many years afterwards in 1895 when he was professor of physiology at Utrecht:

"DEAR PROFESSOR LISTER!

Coming just back from London I have found your kind letter and your most interesting paper on the minute structure of involuntary muscle fibre. I beg you to accept my best thanks for both. I would have been very happy to hear your opinion on different points regarding motion in relation to muscular structure. I am ashamed that I did not know your masterly researches from 1857 when I wrote my paper on the fibrillar structure of contractile substances in 1881. But even Kölliker does not mention them in his 'Gewebe-lehre'!

You are evidently the first who observed clearly the longitudinal fibrils of the non-striped muscle-cells, and you also are the first and till now even the only observer who studied, measured and pictured the different forms of these cells in different phases of contraction! In all the treatises on histology, I know, only relaxed or extended cells are presented and described. In my lectures on physiology I always make drawings of the two extreme states, corresponding to your Figs. 3 and 15, but the latter (maximal contraction) only on the base of theoretical deductions. In future my students will see your figures, taken after nature.

When I get time I hope to repeat your observations and to study the microscopical changes in non-striated cells during contraction with the new microchemical and optical methods. But I fear I shall not come much farther than you have already been nearly forty years ago!!

Believe me with repeated thanks and the highest reverence,

Yours sincerely,

TH. W. ENGELMANN."

The next investigation in order of time resulted in the principal paper of the series, on "The Early Stages of Inflammation,"[1] which was read before the Royal Society of London, June 18th, 1857. It describes a number of beautiful and convincing experiments which he was led to make because of the unsatisfactory state of knowledge of the preliminary stages of inflammation: the very first subject which a lecturer on systematic surgery would have to expound. He endeavoured to start with an open mind, and to base his conclusions on his own direct observation uninfluenced by mere

[1] *Phil. Trans.* 1858, vol. cxlviii. p. 645. *Collected Papers*, vol. i. p. 209.

vague hypothesis. "At the present day," he says, "more especially, when theory is allowed such free scope, and is permitted to attack the most time-honoured rules of practice, we stand in peculiar need of the beacon light of correct pathology, to enable us to steer a safe course amid the various conflicting opinions which assail us."

He had come to the conclusion that accurate knowledge was not likely to be obtained from the contemplation of the more advanced stages of inflammation, marked as they are by secondary processes. He therefore started, in quite a different way from that of his predecessors, by directing his enquiry to the very first deviations from health, hoping to find in them "the essential character of the morbid state most unequivocally stamped."

The observations were made mostly on the frog's web. But he also used the bat's wing in order to avoid the fallacy which might arise from experimenting only with cold-blooded animals. The part was extended on the stage of the microscope, carefully protected from external influences such as that of the vapour of chloroform with which the animal was anaesthetized. The changes were observed and drawn with the *camera lucida*, and noted with punctilious accuracy. The whole paper is typical of Lister's method of conducting experiments.

It is divided into sections.

The *first* deals with the "aggregation of the corpuscles of the blood," which occurs during the process of clotting. It shows that when blood is removed from the body this aggregation "depends on their possessing a certain degree of mutual adhesiveness, which is much greater in the white than in the red discs;[1] and that, in the latter, this property, though apparently not depending upon vitality, is capable of remarkable variations, in consequence of very slight chemical changes in the *liquor sanguinis*."

The *second* deals with the structure and function of the blood-vessels. It shows that the arteries regulate, by their contractility, the amount of blood transmitted in a given time through the capillaries, but that neither full dilatation,

[1] Red corpuscles.

extreme contraction, nor any intermediate state of the arteries, is capable *per se* of producing accumulation of corpuscles in the capillaries.

The *third* section discusses the effects of irritants, such as hot water or mustard, upon the circulation of the part to which they are applied. It shows that the effects are two-fold: first, a dilatation of the arteries (commonly preceded by a brief period of contraction), which is developed through the nervous system and is not confined to the part brought into actual contact with the irritant, but implicates a surrounding area of greater or less extent; and secondly, an alteration in the tissues upon which the irritant directly acts, which makes them influence the blood in the same manner as does ordinary solid matter.[1] This imparts adhesiveness to both the red and the white corpuscles, making them prone to stick to one another and to the walls of the vessels, and so gives rise, if the damage to the tissues be severe, to stagnation of the blood flow and ultimately to obstruction.

The *fourth* section describes the effects of irritants upon the tissues. It proves that those which destroy the tissues when they act powerfully, produce by their gentler action only a condition bordering on loss of vitality—a condition in which the tissues are incapacitated from discharging their wonted offices, but from which they may recover, provided the irritation has not been too severe or protracted. "This suspension of function or temporary abolition of vital energy is the primary lesion in inflammatory congestion; the blood in the vicinity of the disabled tissues assuming the same characters as when in contact with ordinary solid matter, and thus becoming unfit for transmission through the vessels; while the return of the living solids to their usual active state is accompanied by a restoration of the vital fluid to the healthy characters which adapt it for circulation."

The *conclusion* discusses the application of these principles to human pathology, and deals with the mechanism of counter-irritation in words which were often repeated, in lectures and at the bedside, in after years, when Lister was explaining the meaning of such familiar appearances as the almost imperceptible

[1] See page 70.

tible redness of the edges of a wound healing by the first intention, or the diffused blush produced by a tight stitch or spreading from a focus of septic infection.

This paper is much longer than any of Lister's previous writings, and is a more important contribution to science than any of its predecessors. It impresses the reader by the beauty and simplicity of the experiments described, the originality of the thoughts and the soundness of the reasoning. Here and there we meet with statements that are out of date, as when he speaks of "spontaneous inflammation," or of exposure of the feet to cold producing inflammation, or at all events congestion, of the lungs, as if this were the whole story. But we must always bear in mind that at this time nothing was known of the influence of micro-organisms in the production of inflammation. It is possible that Lister had never seen bacteria when he was making these investigations, it is certain that he had no conception then of the part they play in pathological processes.

It has sometimes puzzled modern pathologists that so keen an observer as Lister, during the "glorious nights" poring over the microscope, never detected the "migration of the white corpuscles," that is, the escape of the white corpuscles from the blood-stream through the walls of the capillaries, which was first described by Cohnheim in 1867 as an invariable accompaniment of inflammation.[1] This, however, is probably accounted for by the fact that his researches were confined to the very earliest stages of inflammation, in which this migration, if it occurred at all, would have been so slight as easily to escape notice.

The paper was well received at home and on the continent, and its conclusions have, with scarcely an exception, stood the test of time.

Two other investigations grew out of, or were suggested by, this study of the early stages of inflammation. They formed the subjects of two papers, both read on June 18th, 1857, before the Royal Society of London.

[1] J. Cohnheim, "Ueber Entzündung und Eiterung"—*Virchows Archiv für path. Anat.* 1867, Bd. xl. (Dritte Folge. Bd. x.), p. 1.

One, which was "An Inquiry regarding the Parts of the Nervous System which Regulate the Contractions of the Arteries," [1] deals with a very abstruse physiological subject too complicated for consideration here.

The other, "On the Cutaneous Pigmentary System of the Frog," is of great general as well as scientific interest. [2]

It had been known for some years that the skin of the frog is capable of varying in colour under different circumstances. The fact had been first described by Brücke of Vienna in 1832. In the case of the common frog, Lister said: "I find that this well-known animal exhibits changes of hue almost as great as those of the chameleon, every specimen being capable of varying from a very pale to a very dark colour, the former being generally greenish yellow, but in some varieties reddish; and the latter brownish black, or sometimes coal black; while between these extremes any intermediate shade may be assumed. The depth of tint is generally proportioned to that of surrounding objects: thus a frog caught in a recess in a black rock was itself almost black; but after it had been kept for about an hour on white flagstones in the sun, was found to be dusky yellow with dark spots here and there. It was then placed again in the hollow of the rock, and in a quarter of an hour had resumed its former darkness."

These changes of colour depend upon the concentration or diffusion of dark pigment-granules which are contained in a network of stellate cells, the branches of which, subdividing minutely and anastomosing freely with one another and with those of neighbouring cells, constitute a delicate network in the substance of the true skin.

It had been supposed that the concentration and diffusion of the pigment depended upon the contraction and extension of the branches of the star-shaped cells in which it was contained; and that only these movements of the cells were under the influence of the nervous system.

Lister showed that it was the pigment granules themselves and not the cells that moved, and that this movement is not merely brought about through the influence of the

[1] *Phil. Trans.* 1858, vol. cxlviii. p. 607. *Collected Papers*, vol. i. p. 27.
[2] *Phil. Trans.* 1858, vol. cxlviii. p. 627. *Collected Papers*, vol. i. p. 48.

nervous system, but that it may be caused by the direct action of irritants on the tissues themselves.

These observations disclosed new facts of fundamental importance not only in physiology but also in pathology. They were undertaken because the changes in the diffusion of the pigment were such a striking and invariable accompaniment of the application of irritants to the frog's web in order to set up the pathological process of inflammation. The result fully justified the time spent upon the experiments, for the influence of irritants on the pigment cells was found to be strictly analogous to that produced on the other tissues of the part.

The physiological facts brought out in the course of the enquiry with regard to the parts of the nervous system which control the changes in the colour of the frog are of hardly less importance.

Lister's correspondence shows how much his time was occupied with these researches between 1855 and 1867. The description of them has involved a wide digression. For this one excuse is the importance of the observations themselves, and another that they indicate the prevailing tendency of his thoughts at the time he was delivering his first course of lectures. And there is yet another: that in his later years he feared that this earlier work had hardly received the attention it deserved.

We must now return to Wednesday, November 7th, 1855, on which day it was announced that "Mr. Lister, F.R.C.S.Eng. and Edin., will commence a course of Lectures on the Principles and Practice of Surgery at No. 4, High School Yards." Writing to his brother Arthur he thus described his first appearance:

"I am truly thankful to say that it (my *début*) passed off better than I had any right to expect under the circumstances. For just as I was wanting to prepare the Introductory a fortnight or so ago, I was obliged to write a long answer to a letter in the *Lancet* in reply to one of mine.... Well, the result of this was that of the *21 foolscap* pages of close writing of which my introductory consisted, three only were written on the morning of 3rd day. I went to bed at 2 on 4th day[1]

[1] 3rd day and 4th day stand for Tuesday and Wednesday.

morning and rose at 4, after half an hour's sleep, and got the last words written just in time to go off in a cab to read them! I managed the reading pretty fairly, and the students of whom there were a good number present (I daresay 50) applauded vehemently when I finished. . . .

I have since delivered two other lectures (yesterday and to-day) not reading them, but from short notes, and have got on really as well as I had any right to expect, perhaps better. My class room is very much improved by the alterations made in it: I have already seven pupils entered, I cannot yet at all tell how many will ultimately enter, as many do not take out their tickets till a week or a fortnight, and there are three lecturers on Surgery for them to choose from. It seems queer to take fees from them for tickets, of which I enclose one in due form. Mind the fee is £4. 4. – ! I was so lately a student myself. I feel I have undertaken a most responsible duty: how much may depend on the principles of practice which I impart to these young men! May I be enabled to discharge the duty faithfully. I also feel by the lecture of to-day that a great deal may be said in an hour and that I have plenty of work before me for the winter.

Seventh day is happily a leisure day; except that I have plenty of work for more such days than one in the week. The way I manage work is by getting up early, I go to bed about 10 and get up by alarum at 5.30, light my fire (laid the evening before) and my coffee boils while I dress. I take it and a bit of bread: work for 3 or 4 hours, and off to my 10 o'clock lecture when my mind is brim full of it. Then I have the afternoon for the Hospital: and for preparation in various ways, such as dissection of tumours, &c., and then my evening is all my own for reading, or occasionally dining out (at Millbank I hope)."

It has been said that his first class included only his twelve dressers; but this is clearly a mistake, as he himself wrote that, after a week and a half, twenty-three had already joined.

Long afterwards, Sir John Batty Tuke, looking back through the mists of nearly sixty years, wrote thus to Sir William Turner, who in these early days was demonstrator of anatomy to Goodsir, and very intimate with Lister. "I was one of his dressers, and if I remember right, all of us, the very large proportion of his first class, consisted of his old dressers. The class consisted of nine or ten, and the attendance was most regular. I was his first student, in proof of which I enclose this card which I trust you will be very

Emery Walker ph.sc.

Agnes Lister
from a photograph

careful of. He impressed us all deeply from the beginning both in the wards and the lecture room. He worked us very hard, more especially when he was editing Syme's lectures. The lecture room, which was always called the Old Jerusalem, was immediately opposite the Infirmary gates. What I have said indicates, I think, the deep impression he made upon us. He taught us Pathology more than Surgery. The general impression was that he was a great thinker, and he was treated as such by all the men."

His first lectures were either read or spoken from rather full notes. In subsequent courses he trusted less and less to notes, and at last gave them up altogether. His unpreparedness, and the habit of leaving the finishing touches to the last moment, became even more marked in later life. The last few hours before the delivery of an address were often times of great mental and even physical stress, and it was not uncommon for him to be a few minutes late on arrival.

His father watched the progress of the lectures with great interest and some anxiety, and gave him this excellent advice in a letter dated 11 mo. 21. 1855:

"I was so glad (as we all were) to find thee well embarked on thy course—with so numerous a class for a beginning, and able to pour out to them thy instruction without embarrassment: these, too, mostly somewhat advanced in their studies and therefore making up in credit for thy lectures, if thou canst satisfy them, what they may be deficient in producing emolument. I admire thy morning plan and hope thy early *bed* hour may enable thee to keep to it.

"But was it not running too great a risk and *tempting* failure in thy first lecture to delay till so late its preparation? An example of what is to be avoided hereafter?"

Beyond occasional references to initial anxieties and increasing confidence, little mention of the lectures occurs in the correspondence of the early part of 1856. House hunting and furnishing, and the steps leading up to his wedding, are the chief topics.

The marriage took place in the drawing-room at Millbank, in Scottish fashion, on April 24th, 1856. After a month spent in the English Lakes and at Upton, the young couple

started on a three months' tour on the continent, in the course of which they visited many of the most celebrated medical schools. Lister now made the acquaintance of some of the well-known surgeons of the day, and diligently improved his knowledge of the Italian and German languages. After seeing Brussels and Cologne, going up the Rhine and making a short stay in Switzerland, they crossed by the Splügen to Chiavenna, and so came to Milan. Here the enormous hospital with 3,000 beds did not offer much attraction. He was struck by the huge size of the wards and the early clinique at five in the morning, but, the medical school being at Pavia, he hastened on to that place, where he was hospitably entertained by Porta, the professor of clinical surgery, and Panizza, the professor of anatomy. Here he saw the museums, and the head, forefingers and thumbs of the celebrated Scarpa reverently preserved in spirit, "these being the parts of the body most used in surgery. It was strange indeed to look upon the countenance, very well preserved as it was, of one long since passed away, but whose name and character had long been to some extent familiar to me." Acting on Porta's advice, he went to Turin and Genoa and then to Pisa, where "in the Cathedral we were rather fortunate in happening to witness an interesting though rather sickening ceremony, viz. the Archbishop in full dress, attended by a host of ecclesiastics of various grades, chanting a prayer to Ranieri, the patron saint of the city, to intercede for them so as to prevent the recurrence of cholera and disease of the vines." A strange sign of the times, and of the state of the country, which, in another letter, he describes as "that lovely but melancholy land that we have left; where the people, intelligent, kind, and graceful, live amongst the greatest beauties of Nature, and teeming records of former greatness in science and art, but sleeping in the paralysing chains of political and spiritual tyranny. The cultivators of Medicine, however, are often very active in Italy; I suppose on account of the noble objects and at the same time the unfettered nature of the science."

At Florence they made a longer stay. Here Pacini, the professor of anatomy and physiology, who had already heard

of him and knew of his papers on the iris and the muscles of the hairs, treated him very kindly, and gave him a testimonial and some useful advice. At Padua he was welcomed by Vanzetti, the surgeon, a great admirer of Syme, who had spent a month in Edinburgh two years previously. From Padua a short excursion was made to Bologna with its excellent pathological museum, and they then proceeded to Venice. At Venice and later at Vienna, which they reached by steamer to Trieste and thence by diligence, Lister paid much attention to ophthalmic surgery, in which he was evidently greatly interested at that time.

The medical school at Vienna was the largest and most important he had yet seen. It provided much of general interest; "and best of all as yet, Professor Rokitanski, the most eminent pathologist in the world, spent three hours and a quarter the other day, in going over his wonderfully rich museum of preparations of diseases, to me and some other visitors." Rokitanski was extremely hospitable; he had dined at Upton fourteen years before, and had been much impressed with Lister's two sisters, though he had no recollection of the young surgeon, who, he said, was "nothing in those days." Mrs. Lister, after relating this, continues: "He not only devoted several hours to showing Joseph his museum, (the finest of the kind in Europe) but also insisted that we should *both* spend an evening with him, which accordingly we did, and enjoyed it very much. Mad^me^ Rokitanski seems to be a very nice person, and she was exceedingly kind to us. We were glad to have such a good opportunity of seeing a little of German private life, and found the manners and customs in many respects very similar to our own. The *supper* however was QUITE German. The inhabitants of Vienna of *all* classes dine in the middle of the day, consequently the evening meal is an important affair, and we certainly saw ample justice done to the entertainment at Prof. R.'s. To begin with, a dish of powerfully salted ham, cut in slices, was handed round. Then followed roast goose, accompanied by potatoes curiously prepared, and French beans dressed in something *very* sour. Lastly came cheese and cucumber. Rye bread

and beer formed a not inconspicuous part of the repast. The beer was put on the table in immense glass *jugs* and drunk out of mugs of similar ware, smaller of course though still very large. But the supper itself was not so remarkable as was the Germans' enjoyment of it."

After a few days in Prague and Dresden and a peep at Saxon Switzerland, they came to Berlin, where again Lister was attracted by ophthalmology. He saw "the practice of a very eminent oculist of this capital; he seems a remarkable man; though only about 30 years old, and only having been 4 years in practice, he has already outstripped all the other oculists of Germany by his originality and extreme industry, and now forms one of the chief attractions of Berlin as a medical school. His name is Graefe; he is the son of the late very eminent surgeon of that name. I go to-day by invitation from him, having got a card of introduction to him from a Vienna oculist to whom Wharton Jones gave me one of his cards. My visit to the Professor occupied me 5 hours."

From Berlin they went to Leipzic, where two days were spent chiefly in seeing the ophthalmic practice of Professor Ruete. "I had a card of introduction," he says, "from Wharton Jones, and found him extremely kind and his large clinique in full operation. He has a most beautiful ophthalmic hospital, and devotes a great deal of successful labour to the treatment of its inmates and the instruction of his students.... I also saw the general hospital and the mode of teaching surgery adopted there. The students are made to find out the diseases of newly admitted patients for themselves, and give their reasons and the treatment they would adopt. Thus the teaching has a very practical character, and, what I never saw elsewhere, the two house surgeons themselves perform *every* operation that requires to be done during the last month of the summer session, the surgeon only standing by and directing and assisting them: an arrangement no doubt very advantageous for the young men, but of questionable expediency as regards the interests of the patients."

At Erlangen, an "unsophisticated German town, *very* rarely visited by mere travellers," he hoped to see "young

Heyfelder, a young teacher of surgery whom I once met in England and who promises to attain considerable eminence: but unfortunately I find he is gone to Russia." They then went to Munich, with its large general hospital and important ophthalmic institute, and to Nuremberg, which was a great contrast to Munich "from the fact that its interest is almost entirely connected with byegone days." Kölliker unfortunately was absent from Würzburg, which was a great disappointment. After a short stay at Frankfurt they came to Heidelberg and found "young Professor Chelius whom I wished to see, . . . and he was very civil in showing me all his cases, his instruments and a museum." The last German town to be visited was Tübingen which proved, like Erlangen, to be "thoroughly unsophisticated: being quite out of the way of travellers, and reached only by a diligence from Stuttgart. . . . The Surgeon, Professor Bruns, who was the object of my visit, was very pleasant, and spent a considerable time with me in conversation and in showing me his patients and museum. He seems to me the best surgeon I have seen in Germany, and is exceedingly zealous in his profession."

This was really the end of their tour. One day was spent at Stuttgart, another at Strassburg, and a few more in Paris. The latter part of September was devoted to a visit to his own family at Upton.

This prolonged honeymoon took the place of the continental tour which had been proposed at an earlier part of his career. Including the month in Paris in 1855 he had now spent, in all, four months abroad, at a time of life when he was much better able than he would have been two years before to appreciate what he saw and to derive real benefit from the conversation of the distinguished men whom he met. He had now reached the age of twenty-nine. His education, in the common acceptation of the word, had continued almost up to this time, and it must be owned had been exceptionally complete.

CHAPTER V

ASSISTANT SURGEONCY
(1856-1857)

LISTER and his wife returned to Edinburgh in October, 1856, and settled with much satisfaction into the newly furnished house, No. 11 Rutland Street. Rutland Street has not now a very inviting appearance. It is occupied mostly by business houses and the back of the Caledonian Railway station. It is, however, close to the western end of Princes Street, and was at that time well adapted for quiet residences or doctors' consulting rooms, being within easy reach of the fashionable parts of the town and not very far from the more attractive suburbs.

Those who visit Edinburgh to-day for the first time talk glibly about the Modern Athens, of which, indeed, some features still remain. They admire the broad streets of the new town, and the narrow, dimly lighted closes in the old city, and may even yet appreciate the unspeakable horrors of the "common stair." The classic style of the buildings, the commanding position of the Castle, Holyrood, with its memorable associations, and the occasional glimpses of the Forth, Arthur's Seat, the Pentlands, or the Lammermuirs, still do much to justify its ancient name. But to those who knew it forty or fifty years ago, the perpetual buzz of the tram cables, and the trees blackened by the smoke of countless chimneys which dot the country all the way to Leith and Queensferry, make its other pet name, "Auld Reekie," seem more appropriate.

From the Radical Road under Salisbury Crags, where I often walked with Lister after the customary Sunday afternoon

visit to the Infirmary, it is easy to see at a glance how Edinburgh has stretched out in all directions, and to appreciate the size or rather the smallness of the city in the fifties of last century. The familiar old Infirmary has mostly been pulled down, and has been succeeded by the fine modern structure in Lauriston Place; the links no longer abut upon the country; Millbank with its pleasant gardens has disappeared, and the site has been built over; and houses extend almost without a break right up to the shores of the Forth.

Edinburgh at the time of which we are speaking was even more attractive socially than it is now. The commercial element was less apparent, and the University flavour was proportionately more in-evidence. From the purely professional point of view, it had many advantages. There was ample scope for a limited number of surgeons, though very few confined their practice to pure surgery; and, as it was the chief centre for that part of Scotland, it offered a field for consulting and operative surgery quite out of proportion to the mere number of its inhabitants.

Lister's only private practice as yet consisted in helping Mr. Syme, whose consulting rooms, it will be remembered, were also in Rutland Street. This was not a very great tax upon his time. A quarter of an hour's walk across Princes Street Gardens took him to the Infirmary and the University. Everything, therefore, was now favourable for putting the finishing touches to his second course of lectures, and canvassing the managers of the Infirmary for the impending election for the Assistant Surgeoncy. To this post he was unanimously elected on October 13th, 1856.

He was now hard at work preparing for the reading of his papers on "Involuntary Muscular Fibre" and the "Early Stages of Inflammation," described in the last chapter.

In a letter to his father (October 23rd) he thus explains a prolonged silence:

"'The king, the king's to blame,' only substitute frogs for king. Indeed they have kept me very hard at work, particularly so because the time of my opening lecture is now drawing so near, viz. next 4th day week! Yet I have got many most interesting results from

my Scotch work upon them, *e.g.* I find that the stagnation can be produced equally well upon a dead and amputated foot within a few hours after death. Also that the effect on the pigment cells may be produced by mustard in an ex-sanguine morsel of web cut out and placed on a plate of glass before the mustard is put on it; also that acetic acid, cantharides, croton oil and chloroform all act just as mustard does only with different degrees of rapidity. A quarter of a minute's action of chloroform upon the web is sufficient to induce stagnation which takes place before one's eyes in a beautiful manner. The chloroform of course evaporates very speedily, and leaves the web before stagnation has begun, and then one is at leisure to watch the process which continued for several minutes."

The number of students attending his regular lectures this year was small—only eight—but he was not discouraged. On the opening day, November 15th, he wrote a long letter to his father in which many details are told about the steps by which the observations on involuntary muscular fibre were carried out. He comments on the way in which these confirm Kölliker's views, which had been relegated to the ignominious position of small print in Quain's *Anatomy* to make room for those of Ellis which afterwards proved to be erroneous.

"This, together with the observation on the same tissue in the arteries, showing how the nucleus is surrounded by, and embedded in, the substance of the fibre-cell, seems to me worthy of being communicated to the Royal Society of Edinburgh; and accordingly Dr. Christison, one of the Presidents, has undertaken to read it for me on 2nd day fortnight at the opening meeting of the Session. Dr. C. has been here and seen the thing quite to his satisfaction. I find other observers, Germans, have also been objecting to Kölliker's view, so this communication seems likely to be acceptable.

The paper before the Royal Society is to precede my lecture before the College of Surgeons by 4 days, the subject of the latter being 'The Early Stages of Inflammation as observed in the Foot of the Frog.' The former will serve to allude to when speaking of the structure of the frog's arteries, and so will save time. I find my recent peepings at the frog's foot, I mean since my return to Edinburgh, have tended greatly to simplify the subject."

The preparation for this lecture was conducted in the usual way, experiments and observations going on till the last minute:—"Not half of it yet written," as his father, who was

visiting him in Edinburgh, wrote, "the day before its delivery, and one-third had to be spoken extempore." But he continues, "It was well got through and appeared to give great satisfaction to a very large and select audience. The large room was well filled with the medical and scientific world of Edinburgh, and Joseph, whom I had left with uneasiness between 5 and 6 . . . and who then seemed almost worn down, was so refreshed after his dinner at home that he showed no embarrassment in delivering his subject. . . . He was much congratulated after it by his friends on his success."

In December, 1856, he speaks for the first time of having started some experiments upon the coagulation of the blood, a subject which was exciting a large amount of interest and almost acrimonious controversy, and one to which he was soon to devote a great deal of attention.

But during the spring and summer of 1857 his letters refer mostly to the natural human excitement of the first public operations at the Infirmary, to the beginnings of private practice and to his delight in this part of his work, notwithstanding the overwhelming sense of responsibility which it entailed, and in spite, as he said, in a letter to his mother, of "fearing as I am sometimes apt to do, that a mode of life so much in accordance with my tastes as mine now is must be too pleasant to be proper for me." Most surgeons have a vivid recollection of their first public operations, and will read with interest Lister's description of his state of mind during the ordeal. It illustrates the serious way in which he then, and throughout his life, approached the practical side of the profession of surgery. In a letter to his father (26th February, 1857), written when Mr. Syme was absent from Edinburgh, he says:

"Yesterday I made my *début* at the hospital in operating before the students. I did two operations in presence of a very full theatre, and several surgeons and old practitioners. One an amputation of the great toe, the other Professor Rothmund's operation for the radical cure of inguinal hernia. Mr. Syme had spoken of the latter method favourably with reference to this patient in his clinical lecture before going away. I felt very nervous before beginning, but when I had got fairly to work, this feeling went off *entirely*, and I performed both operations with entire comfort. And I also explained the operations and cases to the

students without embarrassment. Altogether I felt very thankful at the way I was able to acquit myself. Everybody congratulated me afterwards and the students cheered very warmly."

On the 3rd March, he writes to his sister: "One hasty line to tell thee how the second set of operations went off. I performed two more on 7th day before the students: one of them an exceedingly interesting case, and also requiring a very ticklish operation, viz. the removal of a rather large tumour from the armpit, from among large and important blood-vessels and nerves. I felt this would be a fair trial of my self-command: for the business was very much more trying than the amputation of a thigh or any other *ordinary* operation. The theatre was again well filled, and though I again felt a good deal *before* the operation, yet I lost all consciousness of the presence of the spectators during its performance, and did it *exactly* as if no one had been looking on. I feel, I may say, truly thankful I was able to go through it as I did. Just before the operation began, I recollected that there was only one Spectator whom it was important to consider, One present alike in the operating theatre and in the private room; and this consideration gave me increased firmness . . . I trust I may be enabled in the treatment of patients always to act with a single eye to their good, and therefore to the glory of our Heavenly Father. If a man is able to act in this spirit, and is favoured to feel something of the sustaining love of God in his work, truly the practice of surgery is a glorious occupation. I may say I *never* felt better pleased with my profession than now. I must add that the operations both answered well at the time, and that all the four patients I have operated on at the Infirmary are doing well. Of the *permanent* success of the *new* operation it is as yet impossible to speak, but in the meantime the man is free from all danger."

The work at the Infirmary became more and more engrossing. He speaks in August of "having charge of the wards of the junior surgeon who is gone holiday-making," and of "receiving from Mr. Syme the other day a much more important commission, viz. the charge of HIS wards during the rest of the summer, with performance of the operations, and going round the wards with the students in place of him (Mr. Syme). Mr. Syme will attend every day to see any cases particularly desiring to see him, and so I shall have the benefit of his advice. This promises to be of the greatest possible service to me. Mr. Syme also proposes that even

during the winter session I should visit the wards instead of him with the students, and if I can work the thing properly such an arrangement must tend to the advantage of patients, dressers, students, and myself. It is exactly what I should most have wished for."

Such a delegation of duties by the Professor of Clinical Surgery sounds strange to us of this generation. We do not gather that there was any particular necessity for his desiring to be relieved of his work at this time; none is mentioned in the correspondence before us. It is therefore reasonable to suppose that Syme was anxious that Lister should have an opportunity of gaining experience, and showing his mettle in preparation for the more important position it might, at some future time, be his lot to occupy.

Before entering upon these duties, he made a short visit to Ireland to attend the British Association, which, writing on the 17th September, 1857, he says

" had on the whole a very successful meeting in Dublin, very numerously attended, though not by quite so many very eminent men as sometimes. This was said to have been in some instances rather an advantage, as on some former meetings the time of some sections has been very much monopolized by the squabbles of some great ones. Dublin was very well adapted for such a gathering; the environs being so interesting, and the public buildings suited for sections, soirées, receptions, &c. . . . I enclose a copy of one of the 'journals of sectional proceedings': where, among other things, thee will see the fact of my having read a paper mentioned. The Physiological subsection being rather in want of material I was asked if I would give something: and it therefore seemed a good opportunity for publishing my observations on the flow of lacteal fluid in the mesentery of the mouse, made in 1853, just before I left London.[1]

It answered full as well as could have been expected at the time, and is also to appear in the *Microscopical Journal*."

The letter also describes how he met Bowerbank, the celebrated naturalist and palaeontologist, in Dublin, and was

[1] See page 25; and for the text of the paper, see *Collected Papers*, vol. i. p. 25; and *Report of the British Association*, Dublin, 1857, pt. ii. p. 114.

considerably disconcerted by a circumstantial account of certain experiments made by the great man on the coagulation of the blood, which threw a doubt upon his own conclusions; and how he repeated them immediately on his return to Edinburgh and, evidently to his own great satisfaction, obtained quite different results. It concludes with a pleasant account of a meeting with Sharpey and Kölliker, both of whom were at Millbank:

"Dr. Sharpey and Professor Kölliker are both at Millbank, where we dined to meet them both the day before yesterday and the day before that. . . . Kölliker is quite pleased with the muscular fibre paper, and has no objection to urge to the inflammation business. But he does not as yet seem quite prepared to admit the attractions and repulsions as the causes of concentration and diffusion of the pigment granules. He is, however, I think, half convinced, and next 3rd day Agnes and I are to go to spend a long day at Dr. Allen Thomson's place, where Kölliker will be then staying and where Dr. Thomson is to provide frogs, and Kölliker is to *see* the things, without which we can hardly expect him to admit the explanation, particularly as I have not my sketches to show, as they are given in along with the paper. He says, if it *be* so, it is *exceedingly* interesting. He is disposed to fall back upon contraction of *contents* of the cells, supposing the fluid to be very viscid, and capable of contractions as in some infusoria. But Dr. Sharpey quite agrees with me that this would not at all account for the facts as I have described them."

Paget and Sharpey criticized the use of the word paralysis as applied to the movements of the pigment under the influence of stimulation, hinting that the expressions about paralyzing the attractive and repulsive, or the concentrating and diffusing forces in the pigment cells, implied much more than was proved. His father had made suggestions about the form of the paper, and had also said, "I am ready to ask what new points have turned up that make requisite still further experiments with the poor frogs." So he wrote on December 7th, 1857:

"I incline to write a few lines to thee this afternoon, to tell thee of some observations I made a few days ago upon the frog, although I daresay thee may wish I could tell of having done with that animal for good and all. . . . Thee may remember that the observation of

the *paralysis* of the pigment cells in the inflamed part was a very important portion of my labours; as it seemed to show certainly that, so far at least as *that* tissue (viz. of the pigment cells) was concerned, inflammation consisted in *paralysis* of tissue. I felt it, therefore, to be by no means agreeable to have the correctness of that expression "paralysis" questioned by Paget and Sharpey; although I could not but feel that to reply to them involved an argument that might not be convincing to all minds. To that argument I need not further allude here; but I felt very desirous, if possible, of showing in some simple way that the agents which cause inflammation do really paralyse. It occurred to me that the cilia which cover the frog's mouth might perhaps be affected by the agents above alluded to, and I accordingly tried an experiment in the following way. I placed on a glass plate a morsel of the tongue of a frog just killed, along with just enough water for the cilia to play in, and then with the $\frac{2}{3}$ glass, or still better with the $\frac{4}{10}$, I saw the cilia in brisk action. I now brought *near* the piece of tongue, but without touching it, a piece of lint soaked in chloroform so that the vapour might play upon the tongue, and very speedily the ciliary action grew languid and then stopped, but recurred after removal of the chloroform. I made similar experiments with similar results with the vapour of mustard and the vapour of caustic ammonia, in all cases getting temporary impairment and stoppage of the ciliary action, just as I had on former occasions got a temporary effect on the pigment cells with the same agents. I also found that heat, acetic acid, and carbonic acid arrested the ciliary action. In short, all agents that I have yet tried which, when applied to the web, produced the "arrestment" (to use Dr. Sharpey's word) of the changes in the distribution of the pigment granules, stop the action of the cilia. Now there can be no question, I imagine, that the effect produced on the cilia in these cases is one of paralysis, and therefore we need not any longer scruple about speaking of the effect on the pigment cells as of a similar nature. These observations on the cilia are particularly satisfactory, because the scraping off of the ciliated epithelium cells from the mucous membrane does not arrest the action of the cilia, which continue to move as usual on an isolated cell: and this proves that mere removal from nervous or other connection with the rest of the body is not sufficient to produce the paralysis, but that the tissue itself (the epithelium cell) is directly acted on and paralysed by the irritant. It is also very satisfactory to find that another extravascular tissue is similarly affected as the pigment cells by the agents which cause inflammation; and this tends to rivet very surely the conclusion at which I before arrived, that the tissues of the inflamed part are in a state of diminished functional activity.

I do not know whether I have made my meaning understood; if not I can tell thee more clearly before three weeks shall be passed I hope. I believe my paper will be very much improved by remodelling the last section on the plan suggested by Dr. Sharpey, adding this additional matter about the cilia. I am also not at all sorry to omit the historical sketch (which, if I had followed thy advice, would never have been written), and also the concluding remarks, which were much too hurriedly put together."

CHAPTER VI

INVESTIGATIONS ON COAGULATION OF THE BLOOD (1858-1863)

AMONGST the many other occupations and ever-widening interests of the next few years, Lister pursued his investigations on coagulation of the blood with unremitting energy. The subject attracted him not merely by its intrinsic interest and obscurity, but because it was so closely related to that of the early stages of inflammation.

He had before him the observations of the older physiologists, the comparatively modern work of John Hunter, Hewson and Astley Cooper, dating from the end of the eighteenth and the beginning of the nineteenth centuries, and the theories quite recently put forward by Richardson and Brücke, none of which appeared to him to account for some of the appearances he had himself observed.

Moreover, he felt increasingly the self-imposed burden of being an instructor of youth, and the responsibility for giving them something worth having—not mere theories—in return for their fees. It is true that the attendance at his winter course was small. In November, 1858, he had the mortification of beginning his introductory lecture, the result of much thought, to one student only who arrived ten minutes late, and, as Mrs. Lister reported, "passed through the trial of thinking he should have to come home with the lecture unread." From this, however, he was spared by the tardy arrival of seven others. Whether there were ever more than eleven members of the class this year we do not know; but even that number was greater than in any previous session except the first.

In the summer of 1858 he had started a second, altogether different, course of lectures, dealing with surgical pathology and operative surgery. Only seven men attended. He owned to feeling flat at having to lecture to so few, but he recalled the fact that Christison, the popular professor of medical jurisprudence, was said to have lectured for four years to about four students, and reminded his father, who had expressed some anxiety about the class, that he was after all only one of five lecturers on surgery in the University. He was, indeed, much less impressed with the smallness of his class than with the fear that the fundamental facts of physiology which he had undertaken to teach them would be unsatisfactorily explained. This was a powerful stimulus to go on with his work on the coagulation of the blood, and as this subject is often mentioned in his letters, it will be well to give a general summary of it here.

Amongst the *Collected Papers* are five dealing with coagulation of the blood. The first [1] is an account of a case of what is called "Spontaneous Gangrene" in a child (due no doubt to embolism, that is, plugging, by means of clots, of the main arteries of the lower extremities); in which one leg recovered and the other was amputated. The second [2] is a short description of a case in which, relying on the facts he had discovered, he saved from amputation a patient's arm which had been for thirty hours constricted by a tourniquet. The third [3] describes some further ingenious experiments undertaken with the object of confirming or disproving the "Ammonia theory of Dr. Richardson." This was the well-known Sir Benjamin Ward Richardson, the apostle of teetotalism and sanitation. The fourth, and much the most important, is the Croonian Lecture [4] delivered before the Royal Society of London in 1863 when he was a professor with a world-wide reputation. It gives his mature and considered views upon the whole matter. The fifth is an address given many years later, in 1891, to the Medical

[1] *Collected Papers*, vol. i. p. 69. *Edin. Med. Journ.* 1858, vol iii. p. 893.
[2] *Collected Papers*, vol. i. p. 85. *Edin. Med. Journ.* 1858, vol. iv. p. 119.
[3] *Collected Papers*, vol. i. p. 105. *Edin. Med. Journ.* 1859, vol. v. p. 536.
[4] *Collected Papers*, vol. i. p. 109. *Proc. Roy. Soc. Lon.* 1863, vol. xii. p. 580.

Society of London.[1] In this he reviews his old work in the light of new discoveries, especially the chemical discoveries, of the intervening twenty-eight years, and dwells upon the practical applications of this purely scientific investigation.

In the Croonian lecture Lister began by stating the problem in simple language for the sake of those Fellows who were not physiologists; it may be quoted for the sake of the general reader.

"The blood, if examined by the microscope within the vessels of a living animal, is seen to consist of a liquid and numerous small particles suspended in it. The liquid is termed the 'liquor sanguinis,' the particles the 'blood corpuscles.' Of these corpuscles a few are colourless, and are named the 'colourless' or 'white corpuscles.' The great majority are coloured and cause the red appearance of the blood, and hence are called the 'red corpuscles.' Soon after the blood has been shed from the body, it passes from the fluid into the solid form. This depends upon the development in the blood of a solid material termed 'fibrine,' so called from its fibrous nature, consisting, as examined by the naked eye, of tenacious fibres, and having the same characters also under the microscope. These fibres form a complicated network among the blood corpuscles, and from their tenacity are the cause of the firmness of the clot. Soon after the process of solidification or coagulation is complete, the fibrine exhibits a disposition to shrink, and squeezes out from among the corpuscles entangled in its meshes a straw-coloured fluid termed the serum, very rich in albumen, in fact, very similar in chemical composition to the fibrine, which, in its turn, may be said to be identical chemically with the material of muscular fibre.

The question before us, therefore, is What is the cause of the development of this solid material, the fibrine? The subject may be looked at in two aspects—first, as to the essential nature of the process of coagulation; and secondly, as to the cause of its occurrence when the blood is removed from the body."

As regards the first point he could not agree with John Hunter's view that it was "an act of life—analogous, in some respects, to the contraction of muscular fibre," seeing that blood may be kept fluid for an indefinite period by the addition of certain neutral salts, but that at any time this mixture of blood and salts might be made to coagulate by the addition of water. He would not commit himself, in so saying, to

[1] *Collected Papers*, vol. i. p. 189. *Brit. Med. Journ.* 1891, vol. i. p. 1057.

" any particular theory of the nature of life, or even to the belief that the actions of living bodies are not all conducted in obedience to physical and chemical laws."

With regard to the second point—the cause of coagulation—there were three groups of explanations offered: the mechanical, the chemical, and the vital.

The mechanical theory, which was that mere rest was a sufficient cause, he maintained had long since been exploded, though unfortunately it was still taught.

The chemical theory had had numerous advocates. The only one whose views at the time met with a degree of support was Dr. Richardson, who held that coagulation of the blood was due to the escape of a minute quantity of ammonia, which he believed held the fibrine in solution. This suggestion Richardson had made in an essay which gained the Astley Cooper Prize in 1856. Although Lister said from the first that many parts of this proposition were unsound, there were one or two points which he accepted for a time. At last, however, he discarded the ammonia theory as entirely fallacious, and with it all the other chemical theories so far as they had been propounded at the time.

There remained the different forms of the vital theory which had been held by many physiologists, Sir Astley Cooper among the number, and which had recently received powerful support from the observations of Brücke of Vienna. The inference drawn by these observers from their experiments was that the living vessels exert an active influence upon the blood, by which coagulation is prevented.

It is impossible to epitomize the description of the simple and convincing experiments which led Lister to the conclusion that even this, perhaps the most attractive theory, was not the right one. Those who are sufficiently interested must read the original paper. It is one well worthy of perusal. The conclusion ultimately reached was that " the real cause of the coagulation of the blood when shed from the body, is the influence exerted upon it by ordinary matter, the contact of which for a very brief period effects a change in the blood, inducing a mutual reaction between its solid and fluid constituents, in which the corpuscles impart to the liquor sanguinis

a disposition to coagulate." Beyond this he could not go. He made no attempt to explain how this influence was exerted, or how it brought about the disposition to coagulate, though he supplied some analogies from certain chemical reactions.

He showed further that the healthy living vessels did not produce the same effect as, what he called, " ordinary matter " in causing clotting, but also that this was no special property of the vessels, but one which they shared with some other healthy living tissues. When, however, the living tissues ceased to be healthy—when, for example, they became inflamed—they acted towards the blood in the same way as ordinary matter acts. This conclusion, which was of great practical importance, he had reached in the course of his observations on the " Early Stages of Inflammation." [1]

The influence of the living tissues in preventing clotting was a mystery which he thought would never be explained. In the paper on " Spontaneous Gangrene " he said, " Here, then, it appears to me, we have a sure, though imperfect glimpse, of the operation of mysterious but potent forces, peculiar to the tissues of living beings, and capable of reversing the natural order of chemical affinities; forces which I suspect will never be fully comprehended by man in the present state of his existence, and the study of which should always be approached with humility and reverence."

Finally, as John Hunter had noted that the different tissues retain their individual vitality for a variable time after the death of the body as a whole, so Lister showed that, after death, the length of time varied before the various tissues concerned were able to impart to the blood this tendency to coagulation.

The whole outlook of physiologists has changed since Lister worked at this subject. It is now the day of the biochemist. The discussion is carried on in terms of proteins and activating agents and enzymes, puzzling enough to the student of medicine and quite unintelligible to the laity. General readers will perhaps have protested against the preceding explanations as being too technical to be interesting, while scientific men may think that they deal with matters too

[1] *Phil. Trans.* 1858, vol. cxlviii. p. 645. *Collected Papers*, vol. i. p. 209.

simple to be worth recording. It was, however, a real live question at the time. The observations cost Lister an inconceivable amount of labour, and they yielded him and his helpers a vast amount of pleasure. Their accuracy has never been called in question, and, strange to say, with all our increased knowledge about the chemistry of the blood, we are no nearer to determining in what way ordinary matter is able to set in motion those complicated chemical processes which lead to the formation of the clot.

Sometimes it is necessary to dwell at some length upon certain stages of a long life that are almost forgotten. In this particular instance it is more than justified, because Lister's work upon the blood was an essential step in the study of inflammation; and the study of the causes and prevention of inflammation in wounds was his principal achievement.

A few extracts from letters will help to show how the year 1858 saw his position in Edinburgh firmly established.

The paper on "Spontaneous Gangrene" was read before the Medico-Chirurgical Society of Edinburgh on March 18th—"comfortably read," according to Mrs. Lister's account, "though unfortunately there was no one at the meeting who seemed capable of appreciating it, and the remarks made upon it were very poor. The President (Professor Millar) was not present, and in his absence the Vice-President, Mr. Benjamin Bell, was in the chair (there is no harm in giving names even though you don't know the people). He (Mr. Bell) said something about the 'ingenuity' of the paper and the valuable *suggestions* which Mr. Lister had thrown out. 'Suggestions!' when the paper contained perfectly clear demonstration of facts having the most important bearings. There was, however, repeated roughing [Scotch for cheering], and the general opinion appears to be that it was 'a *great success*.' We had a great drive at the end. When we went to dinner the paper was in a most incomplete state, and it required considerable exercise of faith to believe that an hour's more work could bring it nearly to a close. However, about 7 we resumed our labours, and how we did work! Joseph's dictating was really wonderful—keeping me writing

as fast as I possibly could, and the sentences flowing out so smoothly, hardly a word having to be altered. About ½ past 7 we sent for Mr. Craig, whom I have mentioned in a former letter as assisting Joseph. He was fortunately disengaged and came speedily. Joseph, still keeping my pen fully employed, instructed Mr. Craig in the preparation of the *trotters*! [the paper was illustrated by demonstrations of the state of the blood in sheep's feet] and afterwards gave him a quotation from the 'inflammation' paper to copy. At last, at 10 minutes past 8, a cab was sent for, a note or two jotted down for part of the conclusion of the paper, some of it not even noted—and off went Joseph and the manuscript, Mr. Craig and the trotters, in the cab, and arrived at the 'George Street hall' just as Dr. Haldane (who had a communication to read before Joseph's) sat down!! So he had only time to take off his great coat and at once begin."

This is Mrs. Lister's modest account of the way in which she was accustomed to help in her husband's work. Lister in writing to his father the following day, says that she wrote for seven hours one day and eight the next, and "was most helpful in suggestions as to words and arrangement of sentences." In the same letter he enters with much detail into the nature of the experiments and the new facts observed, and the deductions, some of which, however, he afterwards withdrew. He concludes:

"So thee see my inflammation paper receives a powerful *support* from these experiments; for what was then merely an *inference* is now an *observed fact*. I then inferred that as the corpuscles in an inflamed part behave as if outside the body, *probably* the liquor sanguinis tended to do the same (coagulate) were it at rest: now I *observe* that when an agent such as ammonia, capable of producing inflammation, is applied to a part in which the blood is at *rest* in the vessels, coagulation *does* take place in them. And, lastly, I find that the ammonia not only produces coagulation in the *veins* it acts on in an amputated sheep's foot, but produces intense *congestion* and exudation of true *lymph* in the tissues on which the vapour plays. The tension in the blood in the vessels produced by the bandage answers instead of the heart's force in squeezing out the liquor sanguinis. This is, I believe, the first time that inflammation has ever been observed to occur *post-mortem* in one of the higher animals."

CHAPTER VII

SUMMER COURSE OF LECTURES. APPOINTMENT TO PROFESSORSHIP AT GLASGOW
(1858-1860)

LISTER was now beginning to have some private practice, chiefly through Syme's influence, but also in consultation with doctors whom Syme had introduced to him. He took, and evidently gave, pleasure in writing on this subject to his father, and incidentally showed how his scientific work was helping him as a practical surgeon. In one of these letters (June 8th, 1858), he writes:

"Thee enquire about the patient in Stirlingshire. [No doubt a case referred to elsewhere of recurrent haemorrhage from a wound of the palmar arch.] I have had one favourable report of him and hope to hear again to-morrow. It was indeed a very satisfactory case: I hardly knew whether I was not wasting time in tying the artery; and if it had not been for my late experiments with the blood I should I think have amputated the arm. I had another case on 7th day in which my recent experiments with the frog proved of practical benefit. A poor woman had the lower part of the leg crushed by a railway carriage, and I was called to the Infirmary to amputate the injured part. Now in these railway accidents it is often a matter of great difficulty to decide by the appearance of the surface what amount of injury has been done to the interior, because the suddenness of the injury may produce irreparable internal contusion, without the external skin being so much as grazed: resembling in this respect the effect of cannon shot. Well, in the present case I was able to decide on the part where the amputation should be performed, by making an incision into the leg, and finding appearances in the tissues which could have been produced only by the direct violence of the accident, although the exterior surface was natural in aspect. The appearances in question were those of a degree of inflammation such as

could not possibly have arisen so soon *indirectly, i.e.* through the medium of the nervous system in consequence of injury of a neighbouring part. The accident had only happened about half-an-hour before, and *days* would have been required to produce such appearances (viz. intense congestion and effusion of fluid) *indirectly*; but my experiments with the frog had shown that an injurious agent acting *directly* upon the tissues of a part may give rise to such effects in a very brief period. When I began this I did not expect so many words would be necessary to explain the matter, so please excuse my prolixity. I may mention that the patient is doing hitherto as well as I could desire.

I am indeed much pleased with my present class. I find the lectures very profitable to myself, by leading me to review once more all the fundamental doctrines of Surgical Pathology, by the light of my late observations, and I trust this has been the means of dispelling a good deal of mystery from my mind upon some matters of great importance; and I believe the reflections that have arisen from the preparation of these lectures will keep me right in some points where I might have gone wrong in my Royal Society paper. At the same time the students are very attentive, a thing unusual with summer classes: they are commonly all of them present and taking notes diligently on the very elements of Surgery, although they had previously attended two six-month courses of Surgical lectures from others, and some have been dressers at the Hospital under Mr. Syme and attended his clinical surgical lectures. I cannot help feeling a great satisfaction in being able, as I believe, to communicate much new truth to them and clear away much mystery from their minds on points which lie at the very root of successful surgical practice.

Two days in the week are practical or operative days, and I find the plan of having the students to operate or apply apparatus etc. (as the case may be) for *themselves* and before their fellows, after I have explained the principles and details, answer very well. It never seems irksome to the lookers on, each of whom feels that his turn will soon (and he cannot tell how soon) come to be the operator, and therefore pays close attention to the explanation and the whole proceedings; and at the same time he who is operating is of course anxious to avoid making himself ridiculous before his fellow students; and thus they are induced to take that degree of pains which alone makes this sort of work valuable.

The pathological lectures, three days a week, take a good deal of planning and thinking over, as they are entirely different in matter and arrangement from the systematic course in the winter, and thus I find the Royal Society manuscript makes very slow progress."

Two months in the summer were spent at Upton, the time being devoted to this Royal Society paper on the "Functions of the Visceral Nerves and the Inhibitory System."[1] On returning to Edinburgh in September, he had to submit to a contested election for re-appointment to the assistant surgeoncy. His opponent was Dr. Patrick Heron Watson, whose intimate acquaintance he had made as a student; he was at the time one of the extra-mural lecturers on surgery and in after years became surgeon to the Infirmary and developed into an operator of exceptional brilliancy. Lister was re-elected on November 3rd, 1858.

During the year 1859, which was destined to be the last in this stage of Lister's career, there is not much of scientific interest to record. He had become firmly settled in his position at Edinburgh, was gaining many friends and much respect, if but little practice (Mrs. Lister once referred to "poor Joseph and his one patient"), and his summer class was proving decidedly attractive. His father, always cautiously inclined, did not much sympathize with this course of lectures, and Lister thus defends them (April 10th, 1859):

"But I think, if thee knew all the circumstances thee would feel differently regarding it. For my own part I have not a *doubt* that I am right in undertaking it. And really it seems likely to be quite considerable in point of numbers: I have 29 names already of persons likely to attend, and I am told that 24 of these may be regarded as almost certain. If thee consider that I shall have from various circumstances the means of conveying to them practical instruction of the most important kind, which they could not obtain from other sources, I think thee must allow that the object is a worthy one. Then, as regards my position as a lecturer in Edinburgh compared with the four others, with whom I have to compete, thee will see that it must tend greatly to promote my interest to be able to attract so large a number at a season when students are generally idly disposed, and to a course which will not directly help them in getting their much desired degrees or diplomas. I mean a certificate of attendance on the course will be of no use in that way: so that they will come *merely* for the sake of the information to be gained. I trust, however, that the chief object in my mind is that

[1] *Pro. Roy. Soc. Lond.* (1858), vol. ix. p. 367. *Collected Papers*, vol. i. p. 87.

of doing them important good as regards fitting them for treating the diseases of their fellow creatures in after life."

In the same letter he tells of Brown Séquard speaking of "the beautiful researches of Mr. Lister, and giving me the full credit of establishing the essentials regarding inflammation. He has asked me to show him some of my frog experiments: and he and Dr. Bennett [1] are to lunch here for the purpose of seeing them."

In March of this year we hear of the paper on "Coagulation of the Blood" having been translated into German, but no letters at all have been preserved between April 10th and August 1st, when a prospective vacancy for the Professorship of Surgery at the University of Glasgow is announced in the following way to his father:

"I have but little time before post hour for writing to thee upon an important subject. Dr. Lawrie, the Professor of Surgery in the University of Glasgow, is in such a state of health as cannot permit him to hold his office much longer. Indeed, though the representative of the University for the Medical Council, he is obliged to remain at home instead of going up to London to-morrow, as Mr. Syme &c. are about to do, and I suppose has by this time resigned his membership of the Council. The other professors in the Glasgow University are therefore turning their attention to considering who must be Dr. Lawrie's successor in the professorship of Surgery which must soon fall vacant; and Dr. Allen Thomson, one of the most influential of them, has communicated with Mr. Syme to the effect that in his opinion and that of others I am the most suitable person. The appointment rests with Government, and with the present Ministry it appears that I should be pretty sure of being chosen, in consequence of the influence which Allen Thomson and others have with Lord John Russell and Lord Palmerston. It appears that there is no one in Glasgow who comes up to the ideas of the University people, and further, that of Edinburgh teachers I am thought the most suitable. Mr. Syme, in accordance with his uniformly generous course of conduct towards me, thinks I ought to become a candidate; although to himself personally it would evidently be more agreeable that I should stay here and help him at the hospital as well as in private: for there is no one else in this town who is on the same sort of footing with him as myself in surgical matters; and I cannot doubt that he would miss me very

[1] John Hughes Bennett, Professor of the Institutes of Medicine, 1848-74, well known as a physician and a physiologist.

much if I were to go. But thee will be desirous to know what are the advantages offered by the chair. In the first place it would give me at once a clear emolument of £400 to £450 per annum. Secondly, it would in all probability lead rapidly to extensive private practice; the field being very large, and no one having as yet devoted himself to Surgery exclusively in that large city. Dr. Lawrie and his predecessors have been in extensive general practice, surgery entering of course into it: and this I understand in great measure by virtue of the office. And it is Dr. Allen Thomson's opinion that anyone in that office devoting himself to Surgery could not fail to gain practice in Surgery very speedily. Thirdly, I should in all probability be very soon appointed one of the Surgeons to the Infirmary, through the influence of the Medical Faculty of the University (so says Dr. Thomson in a letter to myself). And lastly, the having held that appointment would give me, it appears, an almost certain claim to any Surgical Professorship here that might fall vacant, supposing that I felt disposed to leave Glasgow at all. And again, if any really desirable appointment should offer itself in London, my chances of success would of course be very much greater than if I were a candidate in my present position.

On the whole I cannot but think that I ought to offer myself as a candidate: though I should very much regret leaving Edinburgh, and particularly Mr. Syme, for whom, as thee know, I have a very deep regard; besides that in leaving him I should go away from a counsellor in matters of Surgery such as I could never meet elsewhere, and be thrown entirely on my own resources.

As regards the chances of my permanently settling in Scotland, I hardly know whether they would be much affected by my getting the Chair. For while, as before said, the position would give me greater claim to any London appointment, I do not know that it would make me less ready to accept one that offered. For of course London is in many respects my natural place.

It is under a very curious combination of circumstances that the offer presents itself to me; and I suspect I should be doing wrong were I to throw away the chance.

Please write as soon as thee conveniently can and tell me what thee think of the matter; for Mr. Syme and Dr. Christison being both in London could exercise influence in my favour with the authorities there, if I gave them carte blanche to do so: but this I, of course, have not done without communicating with thee."

There is much to be said in favour of Regius Professorships, *i.e.* professorships the appointment to which is exercised by the Crown. They strike at the root of parochialism in

University patronage by upsetting the mischievous idea that a teacher who has planted his foot on the lowest rung of the ladder has a vested interest in the top rung, if only he can live long enough to reach it. He may attain to any position except the highest, but the heads of departments are selected from outside, or at all events these posts are supposed to be open to candidates from any part of the kingdom. It is the plan which is adopted in most continental countries and in America. It has the advantage of securing on the professoriate not only men who show or once showed promise, but also those who have actually proved their worth. It also counteracts the tendency for the practice and manner of thought of a particular city or school to become stereotyped, and it has the further merit of making young men feel that there may be other openings for their ambition than simply that of following the same road as their predecessors until the melancholy day of superannuation arrives. There are many Regius Professorships in Scotland, some at Oxford and Cambridge and some in Ireland. There are none in London, but then London has not, in the proper sense of the word, ever had a University. Whenever the London University emerges out of chaos it may be expected that the underlying idea, without the name, will be materialized and will lead, so far as the Faculty of Medicine is concerned, both to the advancement of research and to the improvement of education.

The great, it might be said the only, objection to Regius Professorships is the fact that the election is in the hands of a Minister of the Crown, who almost certainly knows nothing about the requirements of the post, and is quite unfitted to appraise the qualifications of the candidates. The chance of success, therefore, depends not only upon fitness for the post, but on the possession of influential friends who are acquainted with the powers that be, and who are willing and able to pull the necessary wires with insistency and yet with tact. All sorts of influences may be at work, even politics or religion may have something to say in the matter, and the candidates are often subjected to a weary and protracted period of anxiety and suspense. Lister's experience did not differ from that of other people in similar positions except

perhaps that, although he started his canvass with some confidence, it had to be conducted with more than the usual amount of difficulty. There were seven candidates: five from Glasgow and two from Edinburgh. In December, a private, though unfounded announcement of his appointment reached him, and in the *Glasgow Herald* of January 18th, 1860, there was a stinging article which showed that the matter was not yet settled. It referred to a rumour that the decision had been handed over to the Lord Advocate and the Government officials at Edinburgh, which intention was believed to have existed, though it had evidently been abandoned. It then drew attention to a circular scattered broadcast amongst the medical profession in Glasgow by the two Members for the city, which, after naming the candidates, went on:

"We request you to inform us which candidate is, in your opinion, the best qualified for the appointment, by placing a cross opposite to his name. You will please return the sheet and post it not later than the 18th current, as we shall decide on the 19th which of the candidates we shall recommend to Sir George Lewis [1] for the appointment.

You will observe that you do not require to attach your signature, and we shall keep the returns strictly confidential.

We are, Sir, Yours faithfully,

WALTER BUCHANAN, M.P.
ROBERT DALGLISH, M.P."

There is no difficulty in agreeing with the *Glasgow Herald* that this "may be a very easy way of solving a difficulty; but it is a queer way of appointing a Professor of Surgery." At the present day it seems almost incredible that such an extraordinary manoeuvre should have entered into the mind of any one, and it is reasonable to think that the Home Secretary was in no way responsible for it. It roused the wrath of the Senatus Academicus, which drew up a weighty protest "against the patronage of the chairs of this University being exercised, on this or any other occasion, under the pressure of sectional or local influence or in any other way

[1] Sir George Cornewall Lewis, Bt., Home Secretary, 1859-61.

than by the unbiassed judgment of Her Majesty's responsible Advisers."

The protest was taken to London by the Vice-Chancellor Thomas Barclay, D.D., who had a personal interview with the Home Secretary and Lord Elgin, Rector of the University; and it is probable that the escapade of the two members, which certainly caused great dissatisfaction both in Glasgow and Edinburgh, turned to Lister's advantage. The appointment was made on January 28th, 1860, and on the 29th he writes to his father:

"At last the welcome news has arrived, announced in a letter from Sir G. C. Lewis's private secretary, signifying that Her Majesty has approved of my appointment. I enclose a copy by Aggie of this important document. It made us almost intoxicated with gladness, doubled or trebled, I doubt not, by the long period of suspense which had preceded it. Indeed I never remember having experienced before such great and unmixed satisfaction at any intelligence. The appointment seems so exactly the sort of thing I could have wished, and, as I think I said once before, I have something like an assurance that, if we are permitted to go to Glasgow, we shall be in our right places there. This feeling it is I hope not presumptuous to think, is confirmed by the remarkable manner in which things have tended to promote the appointment and to enhance its value. For there can, I think, be little doubt that the conduct of the Glasgow Members has been the best possible thing to promote my being well received by the better part of the profession in Glasgow, as well as by the Professors of the University (my colleagues !) and the public. They will be, as it were, bound to clear their city from the charge of narrow-mindedness and clannishness universally made against it in consequence of the conduct of the M.P.'s."

The position that Lister had attained in Edinburgh has been already indicated. He was looked upon as a young surgeon of great promise, whose practice was grounded upon an exceptionally broad foundation of anatomical and physiological knowledge. He was known to be a first-rate experimental investigator, the value of whose researches was already recognized beyond the limits of these islands. It was seen that he took his profession very seriously, and that he inspired his students with enthusiasm, and love and respect for their calling. He had the reputation of being a good

operator with a marked leaning towards conservative, as opposed to brilliant, surgery, and above all he was distinguished for his modesty and transparent honesty. These statements are supported by testimonials. Those who write and read testimonials are well aware that they often paint their subject in too glowing colours, and yet it may be worth while to give one sentence from Mr. Syme's, noted as he was for his terse and thoughtful language.

"He has a strict regard for accuracy, extremely correct powers of observation, and a remarkably sound judgment, united to uncommon manual dexterity and a practical turn of mind."

That is the view of the affectionate relation and, shall we say, partial colleague? It is equally, if not more important, to hear the opinion of those who had attended Lister's classes. Dr. Gourlay, a surgeon in the 2nd Royal Lanark Militia, speaking of the winter course, said:

"With untiring zeal and enthusiasm you combined an earnestness of manner and purpose which invested every subject with an additional freshness and interest. Your ready skill as a draughtsman, also, was of the greatest service in riveting on the mind what had been imparted to it by the ear; and your successful original researches rendered the Pathological parts of the course peculiarly valuable.

As an Operator, I feel I cannot express in too strong terms the opinion I entertain of you. Having assisted you to perform operations of all kinds, I can testify that where the most delicate manipulation was required, as in the extraction of cataract, your steadiness of hand never failed; and where decision and presence of mind, with boldness of execution were called for, you were there equally to be trusted."

One other quotation may be allowed, from the testimonial of Dr. Joseph Bell, then a student, afterwards a friend and colleague. Speaking of the summer course, he says:

"To the excellence of what you taught us your published papers and the approval of the scientific world bear witness; but to the manner in which it was taught none *can* testify so well as your own students. Your Lectures were no mere prelections—the teacher's thoughtfulness compelled the student to think, and his enthusiasm urged his hearers to a like love of science. Neither were they mere scientific curiosities, but at every point the dry details were clothed

with life and interest by the manner in which you pointed out the bearing of structural changes as affecting Surgical practice."

Lister's first sojourn in Edinburgh had lasted nearly seven years. It ended with regretful congratulations from students and the presentation of a silver flagon. There was also a complimentary dinner, attended by a large number of his professional brethren and others, many of whose names are still household words. This was presided over by the genial Dr. Maclagan, for many years the recognized bard at convivial meetings of the University. It happens that this first attempt of Lister's at a non-professional speech is preserved, and it is also recorded that it caused him some anxiety and thought. Though not of great importance, it is interesting as expressing thoughts which will sound familiar to many of his students.

"I beg to thank you with all my heart for the very kind manner in which my health has been proposed and responded to. I feel that you have placed me this evening in a position of honour such as I never before occupied or aspired to. Ever since I first settled here I have entertained a great respect for the medical practitioners of Edinburgh, as occupying a higher place both intellectually and socially than in any other city with which I am acquainted, and this indication of the good-will of those among them whose opinion I most regard, is to me a source of greater gratification than I can express. I feel too that the appointment on which you have so kindly met to congratulate me, however undeserved on my part, is an honourable one and just such as might have been most the object of my ambition, as opening up to me a wider path in that profession which I dearly love.

And yet, gentlemen, I assure you I shall leave Edinburgh with very mingled feelings. For Edinburgh I have conceived a warm affection, not only on account of her transcendent beauty and her wit, but also for her generosity, for which I have good reason to be grateful; for when I came here an entire stranger, she received me with the utmost freedom into her liberal institutions, putting me at once in a position to compete with her own surgical teachers, and giving me a place in her noble Infirmary, and thus affording me the most ample opportunity and the most powerful stimulus to the study of the practice and teaching of Surgery. Your presence, too, this evening, gentlemen, while it shows me in the most pleasing manner how many friends and well-wishers I have in Edinburgh, makes it all the more difficult to part with you; and also I may perhaps be pardoned for making a passing allusion to the domestic

ties which bind me to your city, more especially as one of them has been a source of inestimable advantage to me professionally; I need hardly say I allude to the illustrious Professor of Clinical Surgery. Under this master I have served an apprenticeship from which it has been my own fault if I have not benefited; and however undeserving of the flattering remarks of Dr. Maclagan, I trust I have humbly endeavoured to act in the spirit expressed by the Roman moralist when he says:

'Quid verum atque decens curo et rogo, et omnis in hoc sum.
Condo et compono quae mox depromere possim.'

And even if the days should be near when it will be my business to *use* more than I have hitherto done the stores which I have been laying up, it has occurred to me that the words 'Quid verum atque decens curo et rogo' *ought* to be still a good motto for me and for us all. For us the *verum* will ever be the *decens*;—scientific truth, as bearing directly upon the well-being of our fellow creatures, will always be a becoming object of our pursuit; and while there is probably no calling in which there is greater opportunity for deception than in ours, yet when we consider the sacred interests which are committed blindfold by the public to our trust, we must allow that there is no calling in which falsehood is more unbecoming or more despicable: and if there is one thing more than another connected with this festive gathering which makes me, what if I say? proud, it is that it is composed so exclusively of the good men and the true of the profession in Edinburgh; and I hope that in after life the memory of this evening will be an encouragement to me to shun all tortuous paths, and to pursue that straightforward course of integrity in which I know each one of you would wish to see me walking.

I will not add more, gentlemen, than to repeat that I feel I can very inadequately express my gratitude for your very great kindness to me on the present occasion."

CHAPTER VIII

THE GLASGOW PROFESSORSHIP. SURGEON TO THE ROYAL INFIRMARY. ARTICLES ON AMPUTATION AND ANAESTHETICS

(1860-1862)

LISTER'S election to the Glasgow professorship was in every way opportune. The appointment offered a much wider scope for his abilities than he had hitherto enjoyed, and it came at the particular time of life when he was best prepared to take the fullest advantage of it. He was in the very prime of physical and mental vigour; he had already gained a great reputation, and he had acquired sufficient experience to give him confidence amongst contemporaries or seniors. He had studied the art, or rather the science, of teaching, and he was prepared by what he called the "flatness" of addressing small classes, for the exhilarating effect of speaking to much larger audiences. Moreover, in Edinburgh he had been to some extent overshadowed by the dominating personality of Mr. Syme; and excellent as that influence no doubt was, it was full time that he should be quite independent, and be, as he soon became, *primus inter pares*.

It is true that for a year he was in the anomalous position of being a professor of surgery without a hospital appointment; but he soon was busy enough with private practice to keep his hand in; and the time was well spent in finding his bearings in his new surroundings. The surgeoncy to the Infirmary, when he did obtain it, was incomparably superior to the assistant surgeoncy at Edinburgh. Only those who have occupied both positions can fully appreciate the grave sense of responsibility and the delightful feeling of independence

that come to the assistant surgeon when he is made the head of his department. For Lister it involved in a more striking way than would have been the case in the comparatively healthy wards of the Edinburgh Infirmary, the unwelcome additional responsibility of being brought face to face with rampant septic disease—that bane of surgery which he was destined to trace to its source and in large measure to overcome.

In 1860, Glasgow with its 390,000 inhabitants, though less than half the size of the enormous city of to-day, had already a population twice as large as that of Edinburgh. But the two cities differed not only in size, but in almost every other particular, except that they each contained a venerable Cathedral Church, and each possessed an ancient University, proud of its traditions, dating back, in the case of Edinburgh to the sixteenth, and in that of Glasgow to the fifteenth century.

At this particular time the old University buildings, or "College," had been condemned to be pulled down, and it was during Lister's residence there that the present fine structure was raised on the commanding ridge of Gilmore Hill.

Glasgow had been essentially a commercial and manufacturing centre since the end of the eighteenth century. On the waters of the Clyde the largest vessels could reach the heart of the city, and its banks were lined with almost unrivalled shipbuilding yards. The abundant opportunities for procuring coal and iron afforded facilities for all sorts of manufactures which had flourished exceedingly. Its aristocracy, if the term is allowable, was an aristocracy of merchant princes; and the Glaswegian's point of view is illustrated by the saying that, when he visits Edinburgh and looks from Princes Street across the gardens to the Castle, he is shocked at the large amount of waste ground to be seen on every hand.

The visitor to Glasgow would hardly apostrophize the beauty of its situation, the picturesque grouping of its buildings, or the charm of its immediate surroundings. He is rather impressed by its size, by the signs of strenuous life, by the appearance of prosperity, and often, it must be owned, by its murky atmosphere.

One attraction was the park. In the young professor's

own words: "The Park is within two minutes' walk, and a very fine park it is, and the atmosphere very superior to that of the older parts of the city; though even there it is on many days quite bright and clear." It has greatly changed since then, but though it is now shut in by buildings on all sides, and though its asphalt paths swarm with eager pedestrians and noisy street urchins, it still forms a pleasant green oasis, traversed by the river Kelvin, more poetical, alas, in name than in appearance. It is not now a place for quiet meditation. Formerly it was almost at the edge of the town, the view to the west was not impeded by the University, nor the Western Infirmary, nor the Art Gallery; a row of tall elms ran along the south side, and it is easy to picture Lister here in the early morning, thinking out problems and writing the outlines of papers in his pocket note-book.

There had always been a strong intellectual element in Glasgow. The University had attracted to itself distinguished men in its various Faculties from early times, and diffused its influence widely amongst the more utilitarian branches of the community. Amongst the Faculties those of Divinity and Law occupied the most prominent positions till comparatively recent times. The Medical Faculty had indeed only been an important part of the University since the days of the celebrated Dr. Cullen, who was the first to give systematic instruction in Physic in 1746. At the time of which we are speaking, the medical school was very prosperous, and was resorted to by students from all parts of the Queen's dominions on account of the excellence of its teaching, the lowness of the fees, and the comparative cheapness of living.

Lister was the third occupant of the Chair of Surgery, which had been founded in 1815. The first, Professor John Burns, had held it for thirty-five years. He was followed by James A. Lawrie, whose death was the cause of the present vacancy. Lawrie had been for many years surgeon to the Royal Infirmary and had been extensively engaged in private practice, not, however, purely surgical. No one in Glasgow pretended at that time that his practice was purely surgical. Indeed the idea of a really pure consulting practice of any kind was hardly grasped, even in London, until many years later.

Amongst many congenial colleagues on the Medical Faculty were his fellow-student Dr. Gairdner, the much respected Professor of Medicine, and Allen Thomson, the well-known anatomist and the close ally of Sharpey. On the other Faculties also there was no lack of men of distinction, amongst whom were Thomas Barclay, D.D., the Principal; Sir William Thomson, afterwards Lord Kelvin, Professor of Physics; and Edmund Law Lushington, the Professor of Greek and afterwards Lord Rector, "wearing," as Tennyson, his brother-in-law, said, "all that weight of learning lightly like a flower." George H. Ramsay was the Professor of Humanity; and the Chair of Divinity was soon to be occupied by that master of style and philosophic theologian, Dr. John Caird, who succeeded Dr. Barclay as Principal, and later on gave the Gifford Lectures.

This was the circle, scarcely less brilliant or intellectual than that of Edinburgh, into which Lister was now translated. He came upon the scene at an important crisis in the history of the University, and during the nine years he remained at Glasgow, he took his full share in the work that was involved in the removal of the University from its old to its new quarters.

Before settling into his new home, 17 Woodside Place, the formal "induction" of the new professor took place, at very short notice, on March 9th, 1860. This quaint function, involving the delivery of a Latin thesis, and altogether smacking of antiquity, is thus described in a letter to his father:

"It came upon me suddenly at the last; for I had not expected it to take place last week, the due notice not having been sent me. Consequently, though I had thought what sort of order I should put my ideas down in, I had not begun to write when the letter from Professor Allen Thomson came on 5th day morning informing me that the ceremony was to be gone through next day at 3 o'clock. I was unable to get to work till evening, and then found that a good deal more thinking was necessary before I could actually commence. I was in fact forced to give the night to it, and did not put pen to paper till 2 a.m. At first I found the Latin very irksome, but it became somewhat easier as I went on. Next morning, however, when I got up after a short rest, only about a third of what I

ought to write was done. But I got on better in the morning, and accomplished about another third in the hour and a half which I could devote to it before starting by train. Then, by Aggie's suggestion, I took a Latin dictionary with me in a small carpet bag, and in the railway carriage accomplished the rest, fortunately not requiring the dictionary much. I send it thee such as it is. Thee will I daresay not care to read it now,[1] but at some future time thee may like to look it over. If so thee will be, I imagine, the only person who has *understood* it, except Aggie, to whom I have translated it. Thee will understand it is a fragment only. This was all that was *required*, although I had intended to have made it complete. Thee will understand the 'admodum reverendus' is the Principal, and the 'doctores celeberrimi' the Professors. The *title* was translated by the Professor of Humanity: the subject I chose being 'the Teaching of Surgery.'

Having got to Glasgow I drove to Professor Allen Thomson's house in the College, and got from him a little lunch, and the use of a pen and ink to copy out what I had written in pencil in the train. Then we went together to the room adjoining that where the Senatus were sitting. There he left me, and after a while the porter came to summon me into the dread presence. It was odd to see the faces of all looking up at me, a perfect stranger to most of them, with a sort of mingled amusement and curiosity, amusement at the farce I had to enact, curiosity to see what sort of a being it was who had been so much talked of and who was to be their colleague. I was shown a seat next the Principal, and was soon called on to read my 'dissertation.' This I did pretty comfortably considering; indeed I think I half fancied for the time being that my audience understood me, though probably, except perhaps the Professor of Humanity, no one did so. I was cheered, however, at the compliment to the Professor of Anatomy (Allen Thomson) and when I got half way through the allusion to the amputation at the ankle-joint, I was stopped by the Principal saying 'Satis disseruisti,' and then telling me in English to retire for a few minutes to the other room. I was soon called back and informed that the Senatus had heard my dissertation with great satisfaction, and then, having signed an obligation not to undertake anything designed to damage the Church of Scotland, and another that I would endeavour to promote the interests of Glasgow University, I had to go round and shake the hands of all my colleagues. All, both Arts and Medical, were present except two, unavoidably detained, and I was very kindly received by them. I then took my

[1] Lister's brother, William Henry, had recently died, after a long illness, while on a voyage to Australia.

seat, and at once was supposed to take my part in the business in my new capacity, and was appointed Examiner of the students in Surgery for the year: for the degree. I then had just comfortable time to take the 5 o'clock train for Edinburgh. . . . I know you will be pleased to learn that this annoying business was comfortably got through."

The session opened in May, and Lister at once started the innovation of giving a summer course of lectures, which was better attended than his colleagues anticipated. Writing about it he says:

"This course will have the effect of making me accustomed to speaking in a large theatre, and giving me acquaintance with some of the best students, whom I find nice intelligent earnest fellows, and, if we are mutually pleased, they will communicate their favourable impressions to others. The facilities I have here in every way for prosecuting this course, as compared with the difficulties I laboured under in Edinburgh, are quite delightful: museums, abundant *material*! and good library all at my service, and my colleague Allen Thomson co-operating in the kindest and most valuable manner."

This summer course involved an Introductory Lecture, which was well received. It marks the time when Lister practically gave up speaking from notes. On this occasion and ever afterwards, both at systematic and clinical lectures, he trusted to a few words on a visiting card which he seldom consulted. His public addresses were generally given extempore, however carefully they had been prepared, or however completely, or more often incompletely, they had been written out beforehand.

The summer class was thus in a way a preparation for the more important course which would be given in the winter session. Preparations of a different description consisted in renewing the desks, painting and generally doing up the theatre, at his own expense, and persuading the Senate to carry out some very rudimentary sanitary improvements.

The eventful opening day of the winter session at last arrived, as it has arrived to so many. The anxious wife remains at home wondering how the young professor is undergoing his ordeal. Writing to her mother-in-law, Mrs. Lister drew a picture of the scene, describing the theatre

and " how nice it looks. All so clean and fresh and bright—the green baize on the three doors and the diagram-frame setting off the oak colouring, and the bright little brass handles on the doors setting them off; and a very handsome slate on a frame on one side, and the skeleton nicely mounted on the other. Some plates are hung on the diagram-frame, and some preparations on the nice oak table, and now it is just about 12. Oh! I trust he may be blessed, and believe he will be. His gown will be going on for the first time except when I saw it tried on here. About 5 minutes past! he will be beginning! and how is he getting on?" He was getting on quite admirably, amongst an audience of interested students and anxious friends, and probably some curious critics. The room was full and more than full—the students as they came in looked about them and seemed struck and pleased with the great improvements. They took their hats off, which is remarked on as unusual, and listened to the lecture in perfect silence, which was also apparently a matter for comment. Lister spoke about the importance of surgery, and quoted the favourite saying of Ambroise Paré, " I dressed him, God cured him." He dwelt on the value of anatomy and physiology to the surgeon, and, amongst other surgical matters, on the importance of making serviceable stumps, which he illustrated by a case of amputation of both legs in which his patient was able to dance the Highland fling—a sally which raised a burst of laughter from the stolid youth of Scotland. They also laughed, but less boisterously, at what was described [1] as a *quiet* gentlemanly hit at homoeopathy, and warmly greeted his closing statement of the two great requisites for the medical profession: " First, a warm loving heart, and secondly, Truth in an earnest Spirit."

Syme was much pleased when he heard of the success of the lecture, and wrote one of his characteristic letters, economical of words:

" My dear J.

I am glad to hear from Ramsay that all went well. It being now established that you can please a large class as well as a small

[1] Letter from Lister's friend Dr. R. Hamilton Ramsay to Syme describing the lecture, Nov. 6th, 1860.

one—or I should rather say still better—the game may be considered in your own hands. Wishing you all comfort in playing it out.

Yours affectionately,
JAS. SYME.

Let me hear your numbers."

The number of students at last reached 182, probably at that time the largest class of systematic surgery in Great Britain, if not in Europe, and a very attentive and orderly class it was, who, as we hear, did not even scratch the new desks. Lister found the size of his audience so stimulating "as not only to remove any tendency to hesitation, but to cause both ideas and language to flow in a manner that really surprises me." As to the students, he took them by storm. They became enthusiastic. They made him Honorary President of their Medical Society, and listened to and applauded a learned address. And when the time approached for the election for the Surgeoncy to the Infirmary, they backed his claim in a parchment with 161 signatures, which runs thus:

"We the undersigned Students of Surgery in the University of Glasgow cannot allow this the first session of your Professorship to close without thus formally expressing our high opinion of the lectures which you have delivered, and recording our testimony to your eminent ability as a teacher of Surgery.

Permit us also to express our hope for the sake both of the rising Profession and of the Institution itself, that in the approaching appointment of a surgeon to the Royal Infirmary your application may meet with that success which your ability and position demand."

The surgeoncy was not obtained without a troublesome canvass. What would have happened if he had not been successful it is impossible to conjecture. The matter was not settled till August 5th, 1861, when he had been a citizen of Glasgow for fifteen months, and it was not till November, 1861, that he performed his first operation in public. It was a more trying occasion than his first public appearance in Edinburgh.

Mrs. Lister wrote a glowing account to Lister's mother of what she had heard of the crowded theatre, the critical audience, the anxiety of his students that all would go well, and finally of the "Professor's triumphant success." To this Lister added in a postscript: "I had not hoped to be able so ENTIRELY to disregard the throng of spectators . . . and I

now feel, that with the same gracious help I can do *anything* in that theatre as composedly as if I were dissecting a dead body. It was curious how *entirely* absent any shade of anxiety was during the whole proceedings."

In the meantime his correspondence contains little of scientific interest. There is a mention of the Social Science Association, with Lord Brougham presiding at the age of eighty-two, and " entering with such keen interest and vigour into what promotes the welfare of his fellow creatures," and giving an address which occupied two hours in the delivery. He speaks of a dinner at Wishaw with Lord Belhaven, the uncle of his friend Dr. Ramsay; and of a meeting with Lord Elgin, the Lord Rector. We hear of Mr. Syme coming over to see, with his daughter and son-in-law, the launch of the *Black Prince*, the second British ironclad; and of the opening of the new part of the hospital, which gave it almost as many beds as St. Bartholomew's, at that time the largest hospital in London. There is also a description of his method of conducting class examinations. An example of the way in which this extraordinarily complicated and conscientious scheme was worked out is given in the accompanying note.[1]

[1] The wording of the questions is written out. Below this each question is analysed and the marks obtainable for each section of the answer are placed opposite to it. Thus, one question in March, 1862, was: 'Explain the principles on which simple incised wounds ought to be treated.' This was analysed as follows:

The object is primary union (1) which requires absence of inflammation (1) except the " direct " ($\frac{1}{2}$)	$2\frac{1}{2}$
The injury involves a flow of serum *always* (1) often oozing of blood ($\frac{1}{2}$)	$1\frac{1}{2}$
Either retained prevents union mechanically ($\frac{1}{2}$) also by exciting inflammation ($\frac{1}{2}$) by tension ($\frac{1}{2}$) and decomposition ($\frac{1}{2}$)	2
Hence after removing clots ($\frac{1}{2}$) tying pulsating vessels (1) and using compression if necessary ($\frac{1}{2}$)	$1\frac{1}{2}$
Provide exit for discharges ($1\frac{1}{2}$) approximate edges of skin without occluding ($\frac{1}{2}$) interrupted sutures ($\frac{1}{2}$)	$2\frac{1}{2}$
Approximate deep surfaces by means compressing the body of the wound (1) not edges of skin ($\frac{1}{2}$)	$1\frac{1}{2}$
Sufficient dry porous material to absorb discharges ($\frac{1}{2}$) and leave 3 or 4 days but no longer (1)	$1\frac{1}{2}$
For union requires time ($\frac{1}{2}$) but suppuration occurs in 3 or 4 days (1)	$1\frac{1}{2}$
Afterwards still provide exit for discharge ($\frac{1}{2}$), viz. pus if any ($\frac{1}{2}$)	1

The total for the whole Answer was thus 15.

Opposite this scheme of marking are squares to receive the number obtained by each candidate in a column below his name, and as there were 4 questions, and 78 candidates are dealt with on two folio pages, some idea may be obtained of the minuteness and neatness that were required.

Although the hope was expressed that his colleagues would adopt it, there is no reason to think that they did so, and it is certain that most professors of to-day would say, " It is high; I cannot attain unto it." But even these it is hoped will find the particular illustration set out in the note instructive and not uninteresting. It explains clearly Lister's views about incised wounds at this time, and shows that the subject of decomposition was only valued at $\frac{1}{30}$ of the answer.

At last, on August 2nd, 1861, the reason for his silence about scientific matters is thus explained in a letter to his father:

" And now I may as well mention a thing that I have hitherto refrained from troubling thee with for fear of causing thee needless anxiety. Thee have, I dare say, been wondering why I have not been getting on with my experiments about coagulation &c., and I fear thinking me a little idle. Well, for some time past I have been pondering, and more recently composing an article on Amputation for a *System of Surgery* which is coming out in London in 4 volumes: consisting of articles written by a number of independent authors, all London surgeons of more or less standing in the Profession, except only myself. The subject of Amputation is a very interesting one, indeed has turned out more so than I at first anticipated; and this is a very favourable time for writing upon it, as it is a good deal under discussion just now in the Profession. For instance, the amputation I mentioned as done by me the other day was done in a way never before practised so far as I know, and resulting from the attention I have been giving to the subject of late. Thee will be anxious to know how much I have got done. Well, the worst part of such a thing is the thinking how it is to be done. That has been long since accomplished, and I have this day sent off the former half of the whole affair; for the printer to work at. As I have now finished my summer course of lectures, I shall have fine leisure for completing it, and this I am desirous of doing before I take my holiday. I find this a very nice place for working at: the park being an excellent 'Academia' for peripatetic study, and most of what I have written has been composed there and written there in a little pocket note-book. Now thee will feel more lenient towards my scanty correspondence; for while lectures were going on, and a good deal of time necessarily occupied at the College, it was difficult to accomplish more than was compulsory."

The article on " Amputation " appeared in Holmes's *System of Surgery*. This was one of the first of those compendious

medical encyclopaedias by various authors which have increased in vogue up to the present day. They purpose to give the opinions of the *élite* of the profession in the countries in which they originate, and almost stagger the student by their ever-increasing bulk. This work passed through three editions, and for a time was the most important of its kind in this country. It was no small honour for Lister to be chosen as the one contributor outside the metropolis. The article as it appears in the *Collected Papers* is reprinted from the third edition published in 1883, and it is instructive to compare this with the form in which it was first written. In the edition of 1883 all that is said about dressing is contained in one short sentence: "A stump after amputation is dressed on the same general principles as other wounds." In the first edition, of which we are now speaking, seven pages are devoted to this subject. The essential processes of the healing of wounds are here discussed and elucidated by reference to his own recent investigations on inflammation and coagulation of the blood. This shows how full his mind was of these fundamental matters, and how at this time he was applying them to the everyday practice of surgery. He finally recommends the dry dressing as used by Syme, and notes that during his house surgeoncy in Edinburgh, Syme "was able to state that of the last twenty cases in which he had amputated the thigh in hospital for chronic disease, not one had died." But he observes elsewhere that we can never be secure against the formation of some pus, and gives instruction as to what should be done in the case of the onset of erysipelas or hospital gangrene, as if that were a fate to which any amputation might be liable. He insists on the importance of providing drainage, and refers to the silk or waxed thread ligatures hanging out of the wound. In 1883 this was all beside the point, and it was accordingly omitted.

The article begins with a delightful historical summary, which, together with a clear account of the general principles that should guide the surgeon in deciding what particular amputation to perform under varying conditions, and the above mentioned discussion on treatment, occupies more than half the allotted space. The portion devoted to the description

of particular operations is thus short—very short as compared with the instructions to be found in text-books of operative surgery; but the result is a readable essay, one which can be remembered as a whole, and which, instead of simply enumerating facts, inculcates principles to guide the surgeon in the treatment of extraordinary as well as ordinary cases.

The method of performing amputations is no longer a burning question. We have almost ceased to discuss the merits of those of Teale and Hay, Chopart and Pirogoff, and the rest. In fact, amputations, justly called the opprobrium of surgery, have sunk into the background, partly because they are so much less often required, partly because interest is centred in the vast number of other operations, then undreamed of, that now take up most of the time and all the ingenuity of surgeons. It is therefore unnecessary to discuss the article in detail. But important additions to surgical technique, here first introduced, must be mentioned.

First, Lister described a new method of amputating in the neighbourhood of the knee, which he called a modification of Mr. Carden's with a long anterior flap. It was really quite original, and holds its place at the present time as probably the best operation in this situation.

Secondly, he mentions a tourniquet which he had devised for controlling the abdominal aorta, especially in connection with amputation of the hip joint. It is true that he afterwards found that a precisely similar instrument had been invented by Joseph Pancoast of Philadelphia,[1] and that in later years

[1] Letter from Dr. Pancoast.

"PHILADELPHIA, Jan. 3. 1870.
1030, CHESTNUT STREET.

MY DEAR SIR,

Your esteemed favour reached here, when after the close of our College term I was taking a trip for recreation on one of our great Western Rail Roads.

I am sure that neither of us would wish to do less than full justice to the other, in regard to any matter whatsoever.

For myself if you antedated me in respect of the use of the aortic tourniquet, a small matter in itself, I shall cheerfully give you all the credit thereto belonging.

I forward with this letter, the July number of the *Journal of the American Medical Sciences* for 1866 in which my friend Morton has given an account of my operation.

The only other medical notice was in our Ephemeral publications in

he discarded it in favour of elastic pressure, partly because the tourniquet was difficult of application, partly because in inexperienced hands it was possible by its use to damage the vessels or the intestines. But that it was efficient may be gathered from the following graphic account of a very formidable operation performed by Syme in which Lister applied it himself. (Letter to his father May 4th, 1862):

"Thee have heard of Mr. Syme's very remarkable case of aneurism, and how essential to its success the aortic tourniquet proved. It was an instance of how very little can be trusted to the history a patient gives of his case. From the account of the man, there seemed no doubt that the opening by which the artery communicated with the sac of the aneurism was quite in the lower part of the abdomen, *i.e.* near the thigh; and Mr. Syme hoped, or rather reckoned, that on getting a finger into an opening in the sac, he should be able to get ready access to this opening, and place his finger upon it, so as to prevent the escape of blood from the vessel when the sac of the aneurism should be completely laid open. Accordingly he pushed in a knife, and inserted his finger as he withdrew the instrument, so as to plug the wound, and felt for the opening in the artery; then enlarged the opening enough to get in a second finger, then a third and a fourth, and lastly the thumb and the whole hand and wrist; but could feel nothing of the vessel *at all*! What then was to be done? If he had withdrawn his hand an enormous gush of arterial blood would have followed it, and the patient would very soon have expired on the table! He then told me to screw up my

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June 1860, which is mixed up with an account of the physicians of the Japanese Embassy, who were present at the performance.

You will perceive by the report that my first practical use of the Aortic Tourniquet was made Jan. 13. 1860.

I had for a considerable time had the Idea that pressure on the abdominal aorta might be employed with advantage in hip joint amputations, as I had seen good arise from its use when made with the Fist in hæmorrhage from the uterus, and in secondary hæmorrhage, after ligation of the femoral artery, near Poupart's ligament.

I have recently met two Presbyterian Clergymen from Edinburgh, who gave me the pleasing intelligence that your excellent Father-in-law Prof. Syme is much improved in health. Please present to him my congratulations in this respect.

My last visit to your capital is especially remembered by me in consequence of the agreeable intercourse I had with him on that occasion. That he may still live to enrich and adorn Surgery with more of his grand and ingenious inspirations is the sincere wish

Of yours very faithfully,

JOSEPH PANCOAST."

To PROFESS. LISTER.

abdominal tourniquet which I had brought with me from Glasgow that morning in case it might prove necessary. There was only just room to apply it, for the great aneurism reached from the thigh to 2 inches above the umbilicus, leaving but little space between it and the ribs. However I had ascertained previously that the aorta could be felt by pressing down the fingers above the tumour, and accordingly I had the clamp placed in readiness, and now proceeded to screw it down while Mr. Syme with his other hand felt the femoral artery to ascertain whether its pulsations were commanded by the tourniquet. I had a moment's feeling of anxiety as to how the implement would work; but this was instantly dispelled by the thought of doing the best we could for the poor fellow, and I had not turned the screw many times before Mr. Syme said that all was right, and proceeded to enlarge the wound, when, to my joy, I saw that no arterial blood whatever escaped, and after the removal of pounds of clot, old and recent, we discovered a small orifice in the *roof* of the cavity, which proved to be the opening of the artery, which instead of occupying its usual situation, which would have been below the *floor* of the sac, had been raised up by the blood far above its natural place. The opening also, instead of being near the thigh, was much higher up, *i.e.* much nearer the head than was consistent with the patient's story; and so instead of merely tying the 'external iliac artery,' as had been expected, it was necessary to tie the great 'common iliac' and also the 'external' and 'internal iliacs' which came off from it just at the spot where the opening was situated. It was beautiful to see how the tourniquet answered; a slight turn of the screw either permitted or checked, according to its direction, a stream of blood; in fact, the bleeding was commanded even more readily than that of a wound in the lower part of the thigh is by a common tourniquet. When at last all was completed satisfactorily, and I removed the tourniquet and handed it to one of the assistants, the huge wound meanwhile remaining bloodless, I felt a greater thrill of surgical joy than I ever before experienced; and you know how handsomely Mr. Syme acknowledged my share of the business. It was indeed a remarkable case, and I am delighted to be able to report that the accounts we have of the poor man are those of steady progress. It was a case to test the safety of the tourniquet most thoroughly; for the man was under it upwards of half an hour; yet has never complained of the slightest uneasiness in consequence of it. So it now appears that for the future we may have the haemorrhage in operations for iliac aneurisms and amputations of the upper part of the thigh and at the hip joint as much under control as in the lower parts of the limb! But though Mr. Syme is probably correct in regarding the mode of controlling the bleeding as the chief feature

of the case, with reference to the general subject of surgery; yet I need not say that to attack such a case for the first time in the history of Surgery required a combination of qualities that probably might have been found in no man living besides Mr. Syme. The case is further peculiarly valuable to him as completing a series of aneurism cases that he has lately had, illustrating the new view regarding their treatment which he has been led to entertain. So we may all rejoice together."

Dr. Joseph Bell wrote to Dr. Ramsay:

"The bleeding was most admirably arrested by Lister and his instrument, . . . When the operation was over Syme said publicly, 'Gentlemen, had it not been for this instrument in the hands of my surgical colleague Mr. Lister of Glasgow, the man before you would ere this have been bereft of his life, as I know not how else we could have arrested the bleeding.'"

The aortic tourniquet was much used for many years, but is now only to be seen in museums, the arrest of haemorrhage in operations of this nature being now always secured by simpler means.

The third innovation described in the article on amputation was a method of bloodless operating devised by him in 1863-4, which allowed of far greater accuracy in all operations on the extremities, and greatly diminished the loss of blood. It consisted in elevating the limb for some minutes, and then rapidly screwing up the tourniquet, not upon a pad which simply controlled the main artery, but without the pad, so that the whole circulation of the limb was stopped. Lister showed, though not at this time, that the bloodless condition of the parts was not a mere mechanical result of elevation, but that the sudden emptying of the veins caused a reflex contraction of the arteries.[1] It is remarkable that this very important advance in surgery made little impression till many years later, when Esmarch's method of emptying the limb by the purely mechanical process of squeezing the blood out of the part by means of an elastic bandage was introduced. Lister adopted the india-rubber band which Esmarch wound tightly round the limb before removing the elastic bandage, because it

[1] *British Medical Journal*, 1879, vol. i. p. 923. *Collected Papers*, vol. i. p. 176. *Lancet*, 1882, vol. ii. p. 638. *Collected Papers*, vol. i. p. 186.

proved to be more easy to apply and more efficient than the old and cumbrous tourniquet, but he continued to follow his own plan of elevating the limb in order to render it bloodless.

This matter was fully discussed in a paper which he read before the Harveian Society of London in 1879; and in an address to the Medical Society of University College, London, in 1882. The argument is supported by experiments made on the actual force of the contractions of the heart during systole and diastole; they were conducted by "making the blood write its own record by means of a stream issuing from a minute orifice in a tube tied into an artery, the projected blood being allowed to fall upon a horizontal sheet of paper drawn smoothly past the animal. By such an arrangement, the effects of the varying degrees of pressure of the blood could be observed untrammelled by any resisting apparatus." They were therefore free from the errors involved in the use of various forms of haemodynamometer. Some of these actual tracings are preserved in the Museum of the Royal College of Surgeons of England. Other observations were made on the metacarpal artery of a horse, the animal being so slung that its feet could be raised, depressed, or placed in the horizontal position. At the two meetings referred to, the influence of the nervous system in producing the anaemic condition of the elevated limb was further illustrated by demonstrating the blush which follows the lowering of the limb or the removal of the constricting band. Several other graphic and convincing experiments were shown, for a description of which the reader must go to the text of the two papers.

About this time Lister introduced another addition to surgical technique which, though small, will help to show the direction in which his thoughts were moving at the time.

In those pre-antiseptic days there was great virtue in the silver suture introduced by Marion Sims. Lister became a strong advocate of wire sutures, pointing out that if there were no tension, suppuration did not occur in their track, though it

was seldom absent when silk stitches were used. For the introduction of metallic sutures he devised a needle with an eye at some distance from the end, and beyond the eye two grooves in which the wire lay snugly, so that, if properly twisted, it followed the needle easily. This was the ordinary "wire needle" which was in everyday use for many years and is still to be met with. Few people know that it was Lister's invention. Both silver wire sutures and the needle had their day and served their purpose, but as a result of the introduction of antiseptics they have become unnecessary and have therefore fallen into disuse.

Lister also wrote the article on "Anaesthetics" in Holmes's *System of Surgery*,[1] and treated the subject on the same philosophical lines which had made the article on amputation so interesting. A few opening paragraphs were devoted to history, but the main part dealt with the physiological principles that must govern the safe administration of a general anaesthetic. The details of administration were summed up in a few words.

The science of anaesthesia was in its infancy. Fifteen years before, Morton had first shown the practicability and safety of the employment of ether, and a year later Simpson's experiments had resulted in the introduction of chloroform. Ether was almost always used in America, while in Great Britain chloroform was the favourite drug. The literature on this subject was small, and Lister's article was an important contribution to it. This was not only because of the scientific way in which the matter was handled, but because there was much rivalry and even heated discussion between the advocates of the merits of chloroform and ether. The Americans maintained that ether had the great superiority of being less dangerous, and the minor one of being less likely to cause sickness. The English, and still more the Scotch, on the other hand, asserted that chloroform was at least equally safe, if properly given, and had the great advantage of being more convenient to administer.

The best mode of administration was also hotly canvassed,

[1] *Collected Papers*, vol. i. p. 135.

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some being in favour of the open, others of the closed method. Lister, following Simpson and Syme, was a champion of chloroform and of the open method, and as years went on he was supported by an enthusiastic band of his former students. By the open method is meant the sprinkling the liquid—ether or chloroform or whatever it may be—on a towel or cloth, or a piece of flannel or lint, which is then applied to the face of the patient in such a way that the vapour can be inspired with a free admixture of air. The closed method implies the administration of a more or less accurately measured mixture of the vapour with air by means of some more or less complicated apparatus.

In the Collected Papers the article is reprinted from the third edition of Holmes's *System*, and consists of three parts written successively in 1861, 1870 and 1882. This arrangement shows at a glance what had taken place in the intervals. By 1882 the views of the profession had in many ways altered; observed facts and statistics had been accumulated and the practice of many had changed. Lister himself remained still a strong advocate of chloroform, but he had somewhat modified his method of administration. He followed this modified method during the ten or fifteen years in which he continued in the active practice of surgery. He did not fail, however, to note the altered views of British surgeons with regard to ether.

In 1861 Lister wrote as if chloroform had permanently superseded ether, in fact he practically treated of chloroform only. He started by showing that it affects first the brain, then the spinal cord, afterwards the respiratory functions, and lastly the heart; from which facts—and they are still accepted—is deduced the teaching of the Edinburgh school, that it is needless to attend to the heart because the respiration always fails first. In Edinburgh the administration was, and I believe still is, entrusted to clinical clerks. A folded towel was placed under the patient's chin, his whole face being exposed, and chloroform was poured upon the towel in quantities that astonished and even shocked the visitors from other surgical centres. Yet for years—at least as late as 1870—it was stated that no death had occurred either in the Royal

Infirmary there, or in that of Glasgow, where the same method was adopted. These young clerks, it was maintained, had enough to do to look after the respiration, and they were directed to pay no attention to the pulse. Lister said he would rather trust himself to "one of these young gentlemen" than to the great majority of "qualified practitioners." He held that special anaesthetists were unnecessary; and characteristically deprecated the use of complicated apparatus.

He next discussed the question of shock, and maintained that complete anaesthesia is necessary to prevent it. He said that some deaths were due to the neglect of this principle, and that, excepting only where some unexplained idiosyncrasy was present, most of the fatalities had depended on faulty administration, pointing out how seldom they occurred when some great operation is to be performed, and "the giver of the chloroform is duly impressed with the importance of his office, and bestows the requisite amount of pains upon it. But when some trifle is to be done, the whole affair is apt to be regarded too lightly, and the administration of the anaesthetic is perhaps confided to some unsuitable person, who also allows his attention to be distracted by other matters."

In the third edition of the article he described some experiments which showed that, if the Edinburgh method of administration were adopted, the inspired air contained 4.5 per cent. of chloroform vapour, that is .5 per cent. less than the proportion which Dr. Snow aimed at when using his inhaler and considered a safe percentage.

He also explained the two varieties of stertor, palatine and laryngeal, by means of observations on his own larynx carried out in an ingenious manner with a laryngeal mirror and a plain looking-glass. He was the first to show by what mechanism laryngeal stertor, which is often the warning note of the approach of danger, is relieved by pulling the tongue out *forcibly*, and he mentioned cases where he considered he had saved lives by this means in his own practice and that of others.

The third edition also contains a sharp criticism of the Report of the Committee of the British Medical Association,

which only worked with saturated vapour, and hence obtained results of small value. There follows a careful examination into the observations of Paul Bert, some of whose conclusions he disproved by experiments of his own.

The article is full of original work and supplies much material for thought, but little or no mention of it is made in most modern treatises on Anaesthesia.

CHAPTER IX

CANDIDATURE FOR AN EDINBURGH PROFESSORSHIP. DEATH OF LISTER'S MOTHER. IMPROVEMENTS IN PRACTICAL SURGERY

(1862-1865)

In the spring of 1862 Lister's father reminded him of the advancing years; and he replied (March 13th): "As thee say, I have now arrived at middle life; for I am 35 years old in the early part of next month, just half the three score years and ten! which few must expect to pass, if at all, with so little of 'labour and sorrow' as thy strength exhibits. It seems strange to think that I am half as old as a man of 70! and yet I suppose the remaining half, if passed at all in this world, will go much quicker than that which is gone. Not that it matters much how quickly, if it takes us to the right goal at last."

We may be sure that time was passing all too quickly for one who felt so keenly the allurements of pure science and whose devotion to it was even increased by the excitement of finding a practical application for his discoveries. There was but little time for experiments, though some had to be filched from that which was claimed by hospital work, teaching, and other official duties which continually demanded more and more of his attention. Mrs. Lister mentions, for example, that "another calf was brought in on Saturday, but Joseph could not be ready to make use of it that day, so we kept it in the wash-house till Tuesday evening. Then a good many experiments were made." But for the most part he was occupied with what may be called the ordinary routine duties of a professor of surgery, to which was added that

of secretary to the Medical Faculty. "Often," he says, "I have to dispatch 4 or 5 letters at once that are compulsory; and of late especially I have been occupied with about the hardest work that falls to my lot, examining candidates for degrees. Both the *written* examination (devising suitable questions and perusing the answers to them) [1] and the *oral*, sitting for hours together interrogating successive students, with scarce a moment's respite from close attention, and with the responsibility of judging to one's best ability of the merits or demerits of the men, is very fatiguing work: and coming, as it has done, after anxious visits at the hospital, and along with pretty frequent calls from private practice, and my duties as Secretary above alluded to, it has really left me *no* time of true *leisure* in which alone any letter worth sending could be written."

The class was not so large as during the first session. The numbers then were abnormal, because a great rush of students to the Scottish Universities had taken place two or three years before in anticipation of the new and stringent regulations which had just come into force. It was, however, still a large satisfactory class of one hundred. "The class," he says, "has continued to conduct itself quite to my mind. We have lately been over the subject of amputations, and I have found the advantage of having devoted special attention to it for the article in the *New System of Surgery*; and I felt more than ever satisfied with the new suggestions I ventured to make as to amputating the leg and thigh. I have now got to a part of the course in which I take up subjects which I did not give last year, so as to make the 2 years' course a complete one; and I am engaged at present upon diseases of the eye, which appear to interest the students very much."

Fifty years ago it seems to have been expected that the professor of surgery should deal with diseases of the eye, and no doubt it was a congenial task for Lister; the interest he took in the subject when on his wedding journey will not be forgotten, and we have heard of his extracting cataracts and doing other operations on the eye at Edinburgh. To-day

[1] We have seen what this implied. Cf. p. 93.

a general surgeon who practises, or even professes a knowledge of ophthalmology, is almost unknown.

He found great pleasure in his hospital work, and refers more than once to his new needle and the aortic tourniquet. In November he wrote to his father:

"The commencement of the session reminds me of the anxiety and excitement that attended the opening of my hospital performances last year; contrasting very much with the quietness with which operations in the theatre are now contemplated by us. I have had some very interesting cases, and all has been going on well as regards the great majority of them. Thee would be pleased to see from Ramsay's letter how capitally the aortic tourniquet answered in the case of the enormous tumour of the thigh bone in which Gamgee [1] amputated at the hip joint. Thee may perhaps remember that it was for that kind of case that I originally intended the instrument; *i.e.* for cases in which a tumour of the bone made it impossible to adopt the usual rapid method of operating. It is a curious coincidence, and I believe something more, that the only two cases of amputation at the hip joint in which that tourniquet has been used have done well; whereas I believe only two had *ever* done well in Edinburgh before, one by Mr. Syme and the other by another surgeon, and only one appears to have ever really recovered in Glasgow."

There is little to chronicle during the year 1863. In his letters we meet with references to interesting surgical matters, such as the ligature of the femoral artery in two cases of diffuse aneurism—rare occurrences, in which the sac of the aneurism has burst and the blood has diffused itself amongst the tissues. Both occurred within a fortnight, and both apparently did well. The Croonian Lecture was delivered in June. One quotation only shall be given from the scanty correspondence of this year, which sufficiently explains the situation. It is dated March 29th, 1863:

"I need scarcely assure thee that my scantiness in letter writing proceeds from no forgetfulness of you. But I have a scribe who tells so much and so well of my affairs that it feels less of an imperative duty than it otherwise would to write personally, and if thee knew how much I am driven with occupations of an urgent kind, thee would make even more excuse for me than thee already do. Thee can understand how desirous I must be to make what preparation I can

[1] Lister's fellow-student in London.

for the Croonian lecture, and yet often from week's beginning to week's end I have been unable to give even a *thought* to it, except regret that I *cannot* think of it. Reflection is the most important element in such an enquiry, and requires the mind to be clear. Then the experiments are such lengthy affairs, in the time they take to prepare apparatus and then execute: and then the notes my kind amanuensis takes at the time ought to be revised. And yet to think of beginning to prepare the paper while I feel that there are facts of the greatest importance that only require asking for by way of experiment to obtain, is what I cannot do. Only last night I got one such fact which I must not stop to describe, and there has not been one single experimenting occasion during this session in which I have not got a new fact well worth all the trouble it has cost. The subject is of such intense interest, not only in itself, but especially as the subject of the blood is at the foundation of all pathology, that I am sure my pains are well bestowed.

Yet do not suppose I am overworked. On the contrary, as the session has advanced I have continued to pick up strength, and now I believe Ramsay is correct in thinking that I never was so well at the end of any previous winter session as I am now. I am in fact in thorough vigorous health. Neither lectures nor operations have cost me nearly as much anxiety as previously; and yet I believe I have done both better than before. In fact the absence of anxiety makes both body and mind in a state better fitted to do both subjects justice.

We are to have great doings tomorrow with Lord Palmerston, who has arrived here, and is to officiate tomorrow as Lord Rector to the University."

In June, 1864, James Miller, the professor of systematic surgery in Edinburgh, died, and Lister was asked by his friends in that city to become a candidate for the post, which he was assured he would almost certainly obtain if he acceded to their request. It may seem strange that he should have contemplated, not perhaps with equanimity, but with satisfaction, a second transplantation only four years after settling in Glasgow. Many arguments could be adduced in favour of the proposition, of which the two most important were interdependent. Lister felt his calling to be towards research, and his ambition was to diffuse as widely as possible such discoveries as he hoped to make. In Glasgow his time was too much occupied with routine, and he felt that he was working in a corner with "a

bushel put over any light he might be able to shed." The early morning hospital visit at 8.30 was a serious hindrance to original work, and there was another fatal objection to the Glasgow position, that the hospital appointment was at most for two consecutive periods of five years. This sword of Damocles was unbearable to one who had hardly reached middle life, and no doubt the short-service system accounted for the fact that, though many notable men started their careers in Glasgow, their reputations were made and their lustre was shed elsewhere. Edinburgh offered an easier life; the hospital visit would be at a more convenient hour, and the surgeoncy to the Infirmary, which went with the Systematic chair, would be permanent.

But these were not the only reasons for his becoming a candidate. The Systematic chair in Edinburgh was looked upon in Scotland as the highest surgical appointment north of the Tweed, and it was therefore taken for granted, even by the Glasgow people, with all their high opinion of their own city, that he would like to go to Edinburgh. "Of course reputation," as Lister said, "is not to be thought very much of except in so far as it is a necessary thing for usefulness in my department of practice: and in this point of view it is undoubtedly of great importance.... But as I said just now the estimation in which the position is generally held must be taken into account." It had to be taken into account because work there was done more in the public eye and was subjected to more enlightened criticism; and if the Edinburgh school attracted, as it was supposed to attract, a better class of students, the seed would be sown in a more fertile soil.

Naturally there would be regrets; it would seem like deserting his colleagues and upsetting the arrangements of the school after a very short tenure of office; and although their circle of friends was not so wide as in Edinburgh, both he and Mrs. Lister were feeling very much at home in Glasgow. But, on the other hand, they would be returning into a familiar, not to say a family, circle, no doubt in many ways more congenial and more intellectual. The warm friendship with Mr. Syme was an added inducement, and the question of rivalry between

them either in public or private did not come into consideration, or was only mentioned to be set aside.

Moreover, Lister always looked upon himself as possibly only a bird of passage in Scotland, feeling that, in some ways, London was his natural place; and he thought, if ever a move south were contemplated, Edinburgh would be a better stepping-off place than Glasgow.

After very careful consideration the application and the testimonials were sent in, and the result was looked forward to with almost complete confidence. But the unexpected happened. Local influences prevailed in favour of his opponent Mr. Spence, and, in August, Lister knew that for the present, at all events, the scene of his labours would not be shifted. Thereupon Syme gave him the practical advice to lose no time in publishing some of his wrist cases, adding that it might be some time before he had anything else to publish so valuable or so calculated to establish a reputation in practical surgery. He also expressed the opinion that the Edinburgh candidature, though unsuccessful, would increase rather than diminish Lister's reputation in Glasgow, a line of argument it is difficult, after this lapse of time, to appreciate. Syme's allusion to the wrist cases refers to a subject which had occupied much of Lister's attention during the last two years. The facts were nearly ready for publication, but were not actually published till the following year.

Before the Edinburgh disappointment Lister had been called to the death-bed of his mother, who had long been in delicate health, and for some months seriously ill. She died in September, 1864.

The youngest, and for long the only daughter left at home had married in 1858; and for six years the parents had lived alone in the old house at Upton. The remaining five years of Joseph Jackson Lister's life were tinged by that melancholy which is often the lot of busy men when their time of active work is over. It is true that three of his children were near at hand and a tribe of grandchildren was growing up around him. But, though devoted to him, they were all busy with their own affairs; and he was lonely, sadly

Joseph Jackson Lister

from a photograph by Maull & Co. London

observing that "since his own great loss his friends and contemporaries seemed falling like autumn leaves."

He dwelt much in the past, and being extraordinarily methodical and precise he read over and carefully arranged a selection of letters from which the few family details recorded have been derived. He had kept all Lister's letters from his earliest infancy, as if he foresaw something of his son's future. Up to this time they had been only written occasionally, and were usually prompted by some special occurrence. But now Lister made a promise to write every week, which promise he faithfully fulfilled; and, as might be expected, though more numerous, the letters are less uniformly interesting. The chief solace of his father's declining years was to watch his advance, and the progress of his discoveries; and probably his keenest pleasure was the receipt of these weekly epistles. His own are full of appreciative interest, and are occasionally spiced with a few words of shrewd advice, as when he says: "In thy description of increased ease in lecturing and the superior character of the students, I was gratified to find too that thou hadst been able to be more regular and punctual at the Hospital than before. I can well imagine how difficult this may be, fully occupied as thy time is, but perhaps on that account, to keep in view a habit of punctuality is especially important."

This was in reply to a letter from Lister (November 6th, 1864), in which, after describing his increased ease in lecturing, he continues: "The students seem likely to be more numerous than for the last two years and appear a more intelligent and earnest set of young men than any I have before had to teach. I notice that this year they do what I never knew done before except in the first course of lectures when I was a new comer, and, as it were, needed encouragement, viz. give me applause every morning on my entering the class room. At the infirmary they show themselves very zealous, and follow the cases with their note-books in hand as I never before saw any students do. This, however, is perhaps partly due to myself, as I am more regular and punctual at the hospital than I ever was before." To his father's comment he replied: "I know that my habits well deserved the hint. I am sticking

to regularity at the hospital and feel the great advantage of it."

In spite of these resolves it cannot be said that punctuality was ever one of Lister's striking virtues ; but his unpunctuality did not imply indolence. It was indeed quite the other way. He was unpunctual because his nature rebelled against leaving anything unfinished, and because he was even more sanguine than most men as to the length of time each duty would require for its fulfilment. The result was on the whole good. In the first place all that he did was thoroughly done, and in the second, more time was available for scientific investigations than if he had been inundated by the claims of an enormous private practice, for success in which punctuality is almost essential.

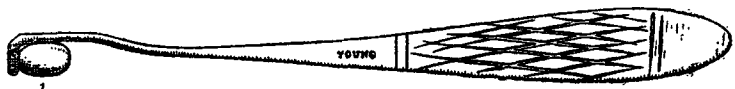
By October, 1864, he was "*completely reconciled*" to remaining where he was, very much occupied with his paper on the wrist-joint, though evidently longing to return to some experiments on suppuration which had been interrupted.

But there were other matters to distract his attention. Gilbert Scott was selected as the architect for the new College, and no doubt had to be accompanied on his visit of inspection to the old College and the site of the new University. The situation of the new College Hospital, now the Western Infirmary, also demanded attention. The site for this was secured in February on a spot separated only by the river Kelvin from the land on which the new College was to be placed. This was said to be healthy, convenient for students, and affording ready access for patients, being close to a main thoroughfare.

Some time was also occupied in perfecting two minor improvements in surgical technique, the first of which is thus described by him in a letter to his father dated November 13th, 1864:

"I had a very satisfactory case the other day, giving me the first opportunity of using to advantage on the living body an instrument (very simple) which I had made some time ago for extracting foreign bodies from the ear. Children often put in objects of a rounded shape, such as small stones, beads etc. etc., and when they are

nearly as large as the *meatus auditorius*, it is extremely difficult to get them out. Attempts with forceps only push them further in, and thus the irritation is increased, and inflammation, it may be fatal inflammation, is induced. The instrument I have contrived is a hook of this shape with the lower end curved so as, if looked at from below (*i.e.* if you look at the instrument endways) to have this appearance, *a*. This curved shape permits the end to be passed with perfect ease between the wall of the canal and the round body, and then a turn of 45° places the end of the hook under the object which comes to occupy this position, *b*, and is pulled out with the utmost ease. The patient was a little girl who had put in a large iron bead two days before. She could not sleep the night before I extracted it, but *next* night and since slept well."



a *b*

This very efficient instrument is now little used. It will perhaps be reintroduced some day, for the extraction of foreign bodies from the ear is not always a simple matter, even with the hooks and bayonet-shaped forceps now recommended for the purpose.

The other improvement in surgical technique, no less interesting in other ways, was concerned with an operation devised by Lister in 1865, but usually associated in this country with the name of another excellent surgeon who described it four years later. It is an example of precisely the same thought occurring to two men. The operation was founded on one performed by Mr. Syme. Lister's contribution just added the desired element of accuracy which was lacking in this previously most indefinite branch of surgery. He never claimed priority and, so far as is known, published nothing on the subject. The matter, which is too technical for the general reader, is more fully dealt with in the Appendix, where a letter from Lister to his father will be found which cannot fail to be appreciated by those who are interested in the history of surgery.

The year 1865 will always be associated with Lister's greatest discovery, but it was marked by no special incidents. During

the remarkably cold winter the public attention was directed to some snowball riots in which the students came into collision with the police; and rather severe and unjust comments were made in England on the supposed roughness of the Scottish Universities. Lister in his letters pointed out that it was a mere boyish freak, which would have passed off quietly if the police had not entered the College Court without orders. His comparison of Scottish and English students is interesting. "They are certainly on the whole extremely well conducted, and in diligence and good behaviour will bear comparison with the best London students, indeed are far superior to the sample I saw at University College, which was above an average specimen I believe." He went on to compare the teachers in Edinburgh with those in London by no means to the advantage of the latter, and pointed out that Lord John Russell had sent his son to the Edinburgh University for a course of study in Arts, and that the Queen had lately sent Prince Alfred to attend classes there.

Lister had always a very great affection for Edinburgh. Before the wrist-joint paper actually appeared in the pages of the *Lancet* he had thought of reading it before the Edinburgh Medico-Chirurgical Society. "After all," he says, "as long as I am living in Scotland, perhaps the Edinburgh Society may seem the most natural one to read the paper to. I confess my pride a little rebels against appearing before the Edinburgh doctors after what has passed, but said pride I must 'put in my pocket.'"

In April of this year the medical profession in Glasgow was painfully interested in a charge of murder brought against one of their number, a Dr. Pritchard, who had long been felt to be a disgrace to the profession for his general bad conduct, and who was ultimately found guilty of poisoning his wife and his mother-in-law. This was one of those *causes célèbres* that fix the public attention, and coming soon after the notorious case of Madeline Smith and another case almost equally well known, brought prominently forward the ease with which poisoning may be accomplished, especially by a doctor. It was thought by the public at large that Pritchard was an eminent medical man, and many feared that, by some legal technicality, or

cloudiness in the minds of jurymen, he might escape under the unsatisfactory verdict of "not proven." This, however, was not the case, and Lister was satisfied with the justice of the decision. "As to the poor wretch himself," he says, "my regard for the general interests of Society keeps me from thinking much of him individually. No doubt within three weeks he will be hung, yet the miserable man still protests his innocence! 'May God have mercy on his soul' is what we may all desire."

Another event of the year was the laying of the first Atlantic cable. The hard winter had been succeeded by a glorious summer. "We are still having most lovely weather," he writes on July 24th. "I hope the same exists and will continue for the next fortnight over the Atlantic into which I suppose the electric cable is being paid out to-day for the first time from the Great Eastern: the shore piece having (as we learn by telegraph) been spliced to the main piece the day before yesterday. One of our professors, William Thomson, will be an anxious man during the process: he takes a deep interest in it, and is in the position of scientific referee on the Great Eastern." As fifty years have passed it may be well to say that the "Great Eastern" was the first of our very large ships, though a dwarf in comparison with the huge modern liners, and to add that William Thomson became Lord Kelvin.

The fine summer led to many pleasant excursions. On one of them he came, for the first time, across the home of one of those students of humble descent who form such an important element in the Scottish Universities, which he thus describes. "Just before setting off (from Dunoon) I spoke to the landlord, John Campbell, about his sons at Glasgow College (for we had learnt incidentally that he *had* sons there, and had seen from prizes of theirs lying about on the table of our sitting room that they were good scholars), when he told me that one of them was beginning the study of medicine, and the other that of divinity! And when I told him who I was, he called the intending medical and introduced him. So odd it seemed! when his sister had been waiting at our table. John Campbell said all he could leave his sons was a good education. That he was giving them; and their

following professions was no wish of his but their own earnest desire. He is so clever a man that it is very possible they may rise to distinction." Perhaps one of them or their children may read of this chance interview with interest.

Throughout the autumn he was working spasmodically, as opportunity offered, at the subject of inflammation and that of suppuration of the blood. No doubt his mind was becoming more and more occupied with these questions on account of the unhealthiness of his wards. He says in one letter, "I have had a good deal to do at the Infirmary lately, and amongst other things is one which I am much pleased with, viz. getting some beds taken out of each of my wards. This will, I expect, make them much more healthy: so that I feel it quite a different thing going into them, so much more airy do they feel."

With the close of the year 1865, that period of Lister's life in which he was travelling along the same lines as other surgeons comes to an end. To some extent, no doubt, he already stood apart from the majority even of the leaders of the profession, inasmuch as his work had been so largely physiological, and because his constant endeavour was to explain phenomena, and base treatment upon this wide scientific foundation. But it was, after all, only a matter of degree. The devoted disciple may see in his achievements, so far, something broader and more far-reaching than in those of his contemporaries, but it would be inexcusable to overlook the work of such men as Bowman and Paget and many others both at home and abroad whose names will go down to posterity.

The main object of all was the same, to improve the Art of Surgery. All of them, no doubt, were burdened with the thought that, however perfect they might render the art, the result was always a lottery, and could say with Pirogoff, "Wir werden aber gleich sehen, wie oft der Zufall, und Manches für uns noch Dunkle und Verborgene in der ärtzlichen Praxis so gewaltig in die Erscheinung tritt, dass alle diese Eigenschaften gar oft dadurch gänzlich paralysirt werden." [1]

[1] "But we shall soon see how often Chance and much that is still dark and obscure for us in surgical practice comes so prominently forward that

Many were striving to dispel this darkness and to remove the element of chance which blocked surgical advance. So far, however, no appreciable light had been thrown upon the subject. It was mysterious, and appeared to be inexplicable. In 1865 Lister solved the problem, and from this time forward he was chiefly occupied in proving that it was no mere blind fate that paralysed surgery, in explaining his discovery to the world, and in showing its application to every department of practice.

Here, then, may fittingly be placed a short account of the last purely technical paper from Lister's pen.[1] It was on excision of the wrist for caries, and had involved much time and thought during the preceding two years.

The excision of joints—that is, the removal of the ends of the bones entering into an articulation instead of ruthlessly amputating the diseased or injured limb—was a comparatively recent development of "conservative surgery." Many thoughtful surgeons had been working at the subject. The risks involved laid it open to criticism, but the occasional brilliancy of the results encouraged them to pursue their investigations. Excision of the elbow had been followed by remarkable success, but that of the wrist, though first performed in 1839 by a German surgeon named Dietz, and subsequently by Heyfelder in 1849, and by many others, had not proved encouraging, and amputation was, in the early sixties, generally considered to be the appropriate treatment for caries (that is tuberculous disease) of the wrist. The most callous surgeon must hesitate before advising such a mutilating operation; and, in Lister's words, "to save a human hand from amputation, and restore its usefulness, is an object well worthy of any labour involved in it." "I told people yesterday," said Syme in a letter dated November 15th, 1864, "that excision of the wrist had hitherto been found impracticable—and that amputation was the rule of surgery—but that the

all these qualities [such as skill, judgment, etc.] are completely paralysed thereby." Nikolaus Pirogoff, *Klinische Chirurgie*, Leipzig, 1854, p. 32. A Monograph on Chance or Luck.

[1] *Lancet*, 1865, vol. i. pp. 308, 335, 362. *Collected Papers*, vol. ii. p. 416.

difficulty had been surmounted by Professor Lister of Glasgow. You should have seen the sensation."

The complicated technique which he ultimately recommended was the result of careful anatomical study. It differed from those of his predecessors in that it involved the complete removal of all the parts in which the disease was likely to recur and that it preserved intact all the structures concerned in the movements of the wrist and fingers. This was adopted by the profession as the classical method of performing the operation, and was, for some years, the only one followed. The introduction of new instruments has led to some modification of details, but the principles laid down by Lister are always followed. The difficulty of the operation and the length of time involved were the only objections raised against it. They were indeed somewhat serious. Lister mentions one which occupied an hour and a half, and adds, "It certainly is a troublesome performance, and I have some fear that others may not give it the pains that it requires." Tuberculous disease was common in Glasgow, and the extensive practice of the Infirmary supplied him with a large number of suitable cases, so that he was able to include in his paper a description of no less than fifteen. "Of these," he says, "two have died of causes independent of the operation, and of the remaining thirteen, one is in an unsatisfactory condition, but not hopeless, two afford a good hope of a satisfactory termination, which in the remaining ten may be said to have been already arrived at."

In view of the enquiries into the causes of suppuration in which Lister was already engaged, two further passages from the paper may be given:

"With regard to the dressing," he says, "after the first twenty-four hours I have found a poultice the best application for a few days, and afterwards lint soaked in a solution of some stimulating agent, such as sulphite of potash, which I tried some time ago, on theoretical grounds, for the treatment of sores, and have found preferable to the ordinary astringents, diminishing the amount and fetor of the discharge, and producing a very healthy state of the granulations. It may be used in the proportion of ten grains to an ounce of water."

The last paragraph of the article tells its own sad story: "On comparing these results with those of previous practice, bearing in mind that the cases include all varieties of carious disease, sometimes in the most aggravated form ever likely to be presented, and also that they have been treated under the disadvantages of a hospital atmosphere, so that I have had to contend in no less than six instances with hospital gangrene and in one with pyaemia, it will, I trust, appear that the principles which have guided me are sound, and afford the means of removing one of the greatest opprobria of modern surgery."

CHAPTER X

HOSPITAL DISEASES

THE foregoing references to the causes of suppuration, pyaemia and hospital gangrene, and the use of poultices, suggest that we should now review the difficulties which hampered the "modern surgery" of which Lister spoke, and made it so completely different from the "modern surgery" of to-day. It is not an easy task. The ground has been gone over by many writers, who proved, and refuted, by means of statistics, one proposition after another, during the years of heated controversy over Lister's teaching; so that, while doctors were left in doubt, the laity were hopelessly confused. Here we shall only state the broad facts, at the same time indicating the direction in which a more minute study of the subject may be profitably pursued. As I worked for a year or two under the unmitigated old regime, I can speak from personal knowledge of its limitations and defects.

Although surgeons were justly proud of the strides that surgery had made, and was still making, and although some considered that, as far as the art of surgery was concerned, it had probably reached its zenith, these advances were microscopic in comparison with those which have taken place since the time of Lister's discoveries, and the field of surgery was almost incredibly smaller than it is now.

Some idea of what has taken place may be gained by comparing the number of operations performed in a few hospitals of different types about this period, with the number of operations performed in the same institutions at the present day.

It is impossible to obtain accurate figures with regard to the Glasgow Royal Infirmary. Speaking very roughly it con-

tained, in 1865, 400 beds for general purposes, and one operating theatre in which 310 operations were performed, of which 19 were gynaecological. In 1913 there were 665 beds for general purposes, and 8 theatres in which 7093 operations were performed.

At St. Bartholomew's Hospital, probably the largest hospital in London at the time, there were, in 1865, 397 surgical beds. The average annual number of operations during the preceding five years was 370, of which 78 were amputations. The number of surgical beds at the present time is rather less—390. In 1912 there were 3561 operations (including 311 gynaecological), of which only 25 were amputations.

University College, Lister's old hospital, may be taken as a type of the smaller London hospitals. It contained, in the late sixties, about 80 surgical beds, served by three surgeons and two assistant surgeons. There was one small theatre and one principal operating day, on which the whole surgical staff assembled, except one of the seniors who preferred to have a day to himself. The number of operations performed in a year was about 200, of which more than 40 were amputations. Now, the hospital, which has been rebuilt, contains about 140 surgical beds. There are three theatres, one being reserved for the gynaecologists, and there are smaller operating rooms in the out-patient department. The two large surgical theatres are in daily, and almost nightly, use; and each surgeon and assistant surgeon is too busy over his own operations and other work to think of watching more than the rarest or most instructive performances of his colleagues. The number of operations performed in 1912 was over 2000, of which only 18 were amputations. On the other hand, 221 were for hernia, mostly for the radical cure, with only 4 deaths; and 169 were for appendicitis. These are striking and instructive figures.

Similar changes have taken place in most of our large towns. Better educated surgeons, fortified by the confidence which Lister's teaching has inspired, have also modernised the old provincial hospitals, or have supervised the erection of countless others throughout the length and breadth of the land, where the same sort of work is being carried out.

As this development of operative surgery has taken place all over the world, it will naturally be asked if there has been a corresponding increase of surgical diseases to account for it; and attention will be drawn to the alarming, but misleading statistics with regard to the supposed increase of cancer, to the Reports of Commissions on industrial and other diseases, to tuberculosis and the unsolved problem of appendicitis. But while cautious statisticians may hesitate to give a positive answer to the question, it can be confidently stated that there has been no such increase in the diseases previously amenable to surgical treatment as to account for the increased activity of surgeons. Operations were few because a large—perhaps the larger—part of the human body was held to be beyond the province of surgery, and was accordingly handed over exclusively to the tender mercies of the physicians. This conclusion was reached, not because ingenious surgeons never thought of making incursions into these forbidden preserves, but because such attempts had been so often followed by disaster.

A few illustrations will show the truth of this statement.

Abdominal surgery, which now supplies a large proportion of the work of a general surgeon, was hardly thought of. It is true that Spencer Wells and Keith, following in the steps of Clay and others, were performing ovariotomy frequently and with increasing success; but even in their skilful hands the mortality was high, amounting to over 30 per cent. of their earlier cases, whereas now in the practice of competent surgeons it seldom rises above 5 per cent.

Practically only one operation was ever performed upon the thorax, namely, the opening of an empyema—that is the letting out of a collection of matter from the pleural cavity. It was inadequately done, and was thought to be dangerous; indeed it was said that no patient over forty ever recovered after this operation.

The spinal canal and the cranial cavity were almost equally unexplored regions. Occasionally the skull was trephined for the purpose of evacuating collections of blood resulting from fractures; or a surgeon of unusual enterprise attempted to deal with an abscess of the brain; but such

operations were rare and seldom successful, however skilfully performed.

On the other hand, amputation was more frequently resorted to than it is at the present day, because attempts at "conservative surgery," which aimed at the saving of limbs, involved such fearful risks to life.

In trying to explain why the field of surgery was so limited and why it has expanded so enormously, it is not fair to give one reason and one reason only. Every branch of science has advanced with great rapidity since the middle of last century, and it was not likely that medicine would lag behind. Moreover, surgery was just beginning to reap the benefit of the great discovery of anaesthesia. But, when all allowances have been made, it cannot be denied that the great obstacle to progress was sepsis; in other words, it was the inflammation caused by micro-organisms, which regularly followed wounds of every description; the extent and gravity of which it was impossible to foretell.

A surgeon had to recognise that there was no security against the simplest and most successful operations being followed by dangerous or even fatal results. When he had closed the wounds "he was," as Volkmann said, "like a husbandman, who having sown his field, waits with resignation for what the harvest may bring, and reaps it, fully conscious of his own impotence against the elemental powers, which may pour down on him rain, hurricane and hailstorm." [1]

The interference of these elemental powers was more common in some hospitals than in others, and was far less frequent in private houses than in hospitals. Thus, while in Glasgow wards had often to be closed on account of the frightful mortality, and in Nuremberg the authorities contemplated pulling down the Allgemeines Krankenhaus for the same cause, there were surgeons in country places who thought the whole trouble was a myth which would disappear under the influence of soap and water and open windows.

[1] "Ueber den antiseptischen Occlusivverband," &c.; "Die Behandlung der complicirten Fracturen"; "Die moderne Chirurgie," *Samml. Klin. Vorträge.* (*Chirurgie*), Nos. 30, 35 & 70, 1874-1881.

Lister, in spite of open windows and meticulous attention to the ordinary rules of cleanliness, had many of these catastrophes in public and a few in private practice. But, so far, his correspondence contains hardly one reference to this gloomy subject. This can only be explained by supposing that he looked upon it as the common lot, and did not allow himself to be so much depressed by it as to lose interest in the improvement of the science to which he had devoted his life. Possibly he did not like to burden his father with accounts of the melancholy side of what he was constantly holding up as the noblest and happiest of callings. We know, however, both from his published writings and from reported conversations, that the anxiety and depression were present, and often very acute. From this time forward, as the light dawned upon him, the character of his writings changed. The nature and prevention of septic diseases now occupied the first place, the development of surgical technique only a secondary position.

Any attempt to realize what teachers taught and students learned, and, in fact what all doctors thought about hospital diseases in 1865, is like trying to appreciate the state of mind of the inhabitants of this planet before they had begun to doubt that it was the centre of the universe.

All the world knows now that very many, perhaps the majority of the diseases to which the human body is liable, are due to microbes. At this time microbes were hardly spoken of, they were not recognized as enemies, but were looked upon as microscopical curiosities. But a certain number of diseases were even then called "septic." Four of these, which were especially liable to follow operations, were called "hospital diseases"—erysipelas, pyaemia, septicaemia and hospital gangrene.

Erysipelas, or "St. Anthony's fire," still occurs sporadically, but hardly ever breaks out spontaneously in a well-regulated hospital. Formerly it was so common that few hospitals were ever quite free from it. It varies in intensity, and corresponding danger, from the angry blush spreading over the face, with which many are well acquainted, to extensive inflammation

and suppuration amongst the muscles, a condition which always involves danger and often ends fatally.

Pyaemia depends upon the formation of septic clots in the veins, parts of which clots becoming detached are carried by the circulation to the lungs and other distant parts of the body, where they give rise to abscesses. It is ushered in by a shivering fit, which is followed at intervals by others. Recovery is rare after the second shiver. Deceptive periods of apparent recovery intervene between the rigors, but the patient usually succumbs in the course of a few weeks. This disease, then of everyday occurrence, is now so uncommon that students often do not see a single case during their two or three years of training in the wards.

The term Septicaemia included—one might almost say still includes—a number of different conditions which are gradually being distinguished one from the other. For the surgeon of 1865 it meant blood-poisoning in which clotting in the veins did not play an important part. Understood in this broad way, septicaemia is still only too common, because microbes can enter the body by many other routes than through surgical wounds: for instance, by means of boils, the stings of insects, or even without any wound at all. But it is a rare event now for septicaemia to follow a surgical incision through unbroken skin.

Of Hospital Gangrene it is difficult to speak definitely. Few living surgeons in this country have personal experience of the disease in hospital practice, and the descriptions of it in books are not sufficiently clear to enable us to form an opinion as to whether it was really a distinct entity, depending upon the influence of a particular microbe. Only two or possibly three cases, and these introduced from outside, have occurred in University College Hospital during the last forty years. It seems to have been a more or less rapidly progressing process of mortification which might attack any wound before it was completely healed. Strong caustics or even the actual cautery often failed to arrest its progress, and it was a frequent cause of death when it involved the upper portions of the limbs or the more vital parts of the body. Hospital gangrene occurred in epidemics,

especially in military practice, and in overcrowded and unhealthy hospitals. Few hospitals of even moderate size escaped its ravages for long periods, and in some of the worst hospitals it became endemic. It was generally thought to be contagious, and the patients often relapsed after apparent recovery.

Lister's own views with regard to hospital gangrene, even as late as the year 1868, may be gathered from the following abstract of notes of part of one of his systematic lectures in Glasgow. First he alluded to its awful frequency; but he added that he hoped the time would come when it would never be seen. He said it was brought about somehow or other by the impure state of the atmosphere produced by the overcrowding of patients with decomposing sores, but that, however crowded the patients might be in *medical* wards, if there happened to be an ulcer it never became affected with hospital gangrene. Long residence in overcrowded surgical wards predisposed to the disease, but there was besides some special poison, for on one limb there might be two sores, one healing and the other affected with hospital gangrene. Sometimes there was an epidemic tendency to this terrible scourge at certain periods of the year both inside and outside the hospital. The foul discharges from sores were not only the predisposing but the exciting cause. To illustrate this he mentioned the case of a man admitted with the disease who infected the patients in beds adjacent to his own.[1]

[1] The following description of the varieties of hospital gangrene is almost in Lister's own words: One variety is where the disease advances with fearful rapidity; here the affected part becomes brown and black, but the blackness is not the same as that of ordinary gangrene, but brownish black. It may be that the inflammation in the vicinity is so great as to cause ordinary gangrene, when the blackness will be of a purplish colour. But hospital gangrene may be extremely languid and then the colour, instead of being brownish black, is pale and grey, such a colour as is produced by caustics on granulations, or as is seen on a "weak" ulcer. There may be no pain and nothing characteristic of hospital gangrene, except that, as you watch it, you find the grey surface steadily increasing in size, and if it be scraped away it is found to consist of a layer of slough one-eighth of an inch or more in thickness. Between these two extremes—the weak form with pus formation, but no pain or inflammatory blush, and the worst form with pain, redness, and constitutional disturbance—there are all sorts of degrees. The constitutional disturbance consists of elevation of pulse, loss of appetite, and generally the symptoms of depression.

These are the four chief hospital diseases which were the nightmare of operating surgeons. But there were others, less common, which, like them, have been almost completely abolished from hospitals. Such are Tetanus or lock-jaw, and Spreading Gangrene.

The most dreaded of these was Tetanus, because it was so painful and because there was no known cure for it. Long before pathologists had begun to guess its true nature, certainly as early as 1872, Lister hazarded the suggestion that it was of microbic origin, because it became so much less frequent in Edinburgh after the banishment of the recognized Hospital Diseases. When the tetanus bacillus was discovered he made another suggestion of almost prophetic nature; namely, that possibly the organism flourished best in suppurating wounds, and that the diminution in the number of such wounds had caused the disappearance of tetanus. It is more likely, however, that the precautions now taken against the carrying of infection by means of hands, instruments, or sponges, really accounts for the improvement. Cases of latent or developed tetanus are occasionally admitted into hospitals, but it does not now spread from patient to patient. Formerly all wounds, especially burns, were liable to become infected, and epidemics of tetanus were looked forward to as inevitable, just as much as were epidemics of erysipelas or hospital gangrene.

The opportunities for the transference of disease from one patient to another were as great as the precautions to prevent it were inadequate. It is impossible to understand why this subject was so much neglected, unless we keep reminding ourselves that the germ theory of disease had hardly been thought of; and that, even if a few enlightened pathologists had begun to grasp its meaning and see its importance, nobody accepted it as a practical working hypothesis. In fact, no theory had been brought forward which afforded a rational explanation of the nature of hospital diseases. Surgeons therefore were fighting these plagues in the dark, or submitting to them as inevitable. The only undisputed fact was that they were favoured by dirt and over-crowding, especially by overcrowding with patients who had suppurating wounds. It was consequently assumed,

and apparently with much reason, that pollution of the atmosphere was the chief thing to be avoided. Accordingly more cubic feet were allotted to each bed; the accumulation of suppurating cases in close proximity to one another was discountenanced; and the ordinary rules of cleanliness, as they were then understood, were more or less rigidly enforced.

But even in the cleanest wards this did not amount to much. One or possibly two jugs and basins and a few towels were considered sufficient for the ablutions of the staff, and nothing more potent than soap and water, possibly tinted with a dash of Condy's fluid, was used to purify their hands. No more efficient means were employed for the cleansing of instruments, including the common probe which circulated from patient to patient, or for washing the marine sponges which were then in common use.

But if these futile attempts at surgical cleanliness excite a smile, still more would the habits of the staff, acting according to their lights, have astonished a modern observer. The nurses indeed presented a neat and clean appearance in that limited number of institutions which had felt the influence of Florence Nightingale. But no such attempt to satisfy the proprieties was made by the surgeon and his assistants. When a dresser or a house surgeon entered upon his term of office he hunted up an old coat, in the lapel of which he probably carried a wisp of ordinary whipcord for tying arteries. This garment did duty for six months or a year, and was then very properly discarded. There was no such time limit however for the surgeons themselves. Their operating coats lasted from year to year, and eventually acquired an incrustation of filth of which the owners appeared unconscious, or even proud. This set the tone, and some who were then young can remember the scorn with which they were greeted when, in their reforming zeal, they broke away from ancient custom, boldly took off their coats, and operated with up-turned shirt-sleeves.

Nor was this all. Although cases of erysipelas were removed to special erysipelas wards, where these were provided, patients stricken with the other hospital diseases were left side by side with the healthy patients, the nurses and dressers passing indiscriminately from one to the other. Dusty pictures lined

the walls. The sanitary arrangements were primitive; in Glasgow Lister complained that the closets communicated directly with the wards, by no means an exceptional arrangement. The supply of water in the theatres and other parts of the hospitals was often wholly inadequate. Finally, and perhaps worst of all, the duties of the house surgeons often included the making of post-mortem examinations, from which they might be called away to assist at an operation or to deal with some accidental wound after such slight purification as decency appeared to demand.

All this shows that our fathers, in spite of their advocacy of cleanliness and pure air, had succeeded unconsciously in providing the best posssible forcing houses for the propagation and transplantation of hospital diseases. They were not ashamed to speak of "a good old surgical stink," and hardly noticed the sickly odour which at all times pervaded the wards.

Something rather more definite must now be said as to the frequency with which hospital diseases occurred, and the amount of injury they produced.

During the ten years or more of heated controversy over Lister's doctrines, many books were written full of contradictory statistics. These it is not proposed to criticize, and certainly not to reproduce. It is, however, impossible to avoid figures altogether. A limited number, together with some quotations from Lister's writings and those of his contemporaries, will place the matter in a sufficiently clear light.

After describing the then "new Surgical Hospital" at Glasgow, he says:

"But, to the disappointment of all concerned, this noble structure proved extremely unhealthy. Pyaemia, erysipelas, and hospital gangrene soon showed themselves, affecting, on the average, most severely those parts of the building nearest to the ground, including my male accident ward, which was one of those on the ground-floor; while my female ward was on the floor immediately above." . . . "At this period I was engaged in a perpetual contest with the managing body, who, anxious to provide hospital accommodation for the increasing population of Glasgow, for which the Infirmary was by no means adequate, were disposed to introduce additional beds beyond those contemplated in the original construction. It is

I believe, fairly attributable to the firmness of my resistance in this matter that, though my patients suffered from the evils alluded to in a way that was sickening and often heartrending, so as to make me sometimes feel it a questionable privilege to be connected with the institution, yet none of my wards ever assumed the frightful condition which sometimes showed itself in other parts of the building, making it necessary to shut them up entirely for a time."[1]

He then went on to explain why these wards were "some of the most unhealthy in the kingdom," and gave a gruesome description of the pits in which the patients who had died of cholera in 1849 had been buried. The "uppermost tier of a multitude of coffins" reached to within a few inches of the surface of the ground, and was only separated by a basement area, four feet wide, from his male accident ward. Almost equally horrible is his account of the "pit burial" of paupers in the old Cathedral Churchyard, which, then as now, is conterminous with the grounds of the Infirmary—at the present day a useful open space, and an innocuous *memento mori*. No actual figures are given, but even if they had been forthcoming it would have been unfair to use as an illustration a building placed amongst such noisome surroundings that it seemed almost providentially prepared for the investigation that was about to take place.

We will therefore turn again to Lister's old hospital in London, which was founded in 1833 and was considered at the time up to date. It faced the fine open quadrangle of University College, and there was nothing abnormally insanitary in its neighbourhood. During the year 1872 a careful record of the incidence of "hospital diseases" in University College Hospital was instituted by Marcus Beck, a young surgeon of great ability, much beloved and admired, and whose too early death was deeply lamented by his contemporaries. He was a cousin of Lister's, had lived with him while studying in Glasgow, and was one of his most faithful disciples. He was trying to discover how far, if at all, these diseases were infectious and whether they were influenced by climatic conditions, or attacked particular

[1] "On the Effects of the Antiseptic System of Treatment upon the Salubrity of a Surgical Hospital." *Collected Papers*, vol. ii. p. 123.

wards or particular beds. Some not very successful attempts at reform were being made in 1872, but notwithstanding this, seven cases of pyaemia and twenty-one of erysipelas originated in the surgical wards, which it will be remembered contained only eighty beds. Eight cases of erysipelas and one of septicaemia were admitted into the hospital. Six of the cases of pyaemia and four of those of erysipelas were fatal.

If the records of other London hospitals are searched they will be found to correspond pretty closely with these; few were better, and some decidedly worse.

Beck was at this time on terms of the closest intimacy with Mr. Erichsen, the professor of clinical surgery, under whom Lister had served as house surgeon in 1850–51. Erichsen, who revelled in statistics, and never really grasped the new situation, delivered a course of lectures in 1874 on "Hospitalism and the Causes of Death after Operations."[1] This booklet of 100 pages supplies the data we are seeking, and explains in a graphic manner the mental aspect of the middle-aged London surgeon at that time towards the whole question.

As regards the mortality he says, "I have been in the habit of publishing, in the successive editions of the '*Science and Art of Surgery*,' the results of all the amputations that have been performed in my wards. They amount to a grand total of 307 cases; of these, 79 have died, being a mortality on the whole of as nearly as possible 25 per cent." And later, "Now a general mortality for many years of from 24 to 26 per cent., in all major amputations of the limbs for all cases, may be considered a very satisfactory result, although there can be no question that it is one that admits, and that ought to be susceptible of improvement. If we compare it with the results that have been obtained elsewhere, it is one of which we need not be ashamed."

He goes on to say that the mortality after amputation was

"at the Edinburgh Infirmary, 43 per cent.; and at the Glasgow Infirmary, 39.1 per cent. The American returns are very good: thus I find that at the Pennsylvania Hospital, the reports of which have been most accurately kept for a long series of years—from 1831 to 1860—the average mortality is very low, being only

[1] London, Longmans, Green & Co. 1874.

24.3 per cent.; whilst at the Massachusetts General Hospital, Boston, out of 692 amputations, there were only 180 deaths, or a mortality of 26 per cent. These figures correspond, as nearly as possible, with those of University College Hospital.

The Mortality in the Parisian Hospitals, on the other hand, is far greater than that in London. As given by Malgaigne and Husson, Holmes and Bristowe, it amounts to about 60 per cent. Lefort states that in Paris, from 1836 to 1863, out of 682 amputation cases, 397, or 58.8 per cent. died. Billroth, when at Zurich, performed 163 amputations between the years 1860 and 1867. Of these 75 died, or 46 per cent. At Vienna in 1868 his amputation mortality amounted to 43.4 per cent., but in 1869-70 it had fallen to 26.08. The number of cases was, however so small—only 23 in each series—that much importance cannot be attached to this. Thus it will be seen that a mortality of from 25 to 30 per cent. is considerably below the average of most metropolitan hospitals in this country and far below that on the Continent."

In military practice the mortality after amputations sometimes reached the appalling ratio of 75 to 90 per cent.

In these tables the cause of death was not sufficiently accurately recorded for our purpose. The probable proportion of the total mortality due to hospital diseases may however be gathered from some figures which are given on a later page. Here he gives a table showing the summary of results of amputations in four Metropolitan hospitals, containing between them about 1800 beds, in which death from pyaemia and shock are recorded. The figures refer to various periods between 1861 and 1872. Out of 631 major amputations 239 died, 86 from pyaemia and 24 from shock. The total average mortality was thus 38.3 per cent., the average mortality from pyaemia alone rather over 6 per cent.[1] It is certain that the mortality from "hospital diseases" was very much larger than that attributed to pyaemia, and the same may be said as regards the other statistics he gives, for there were many euphemistic phrases, such as "acute sinking," for which modern pathologists would unhesitatingly have substituted "septicaemia."

These figures supply something more definite than general statements which, though easily made, are unconvincing.

[1] I have ventured to correct the figures as regards the percentage of deaths.

They are perhaps as good as can be offered, but they are far from satisfactory, because they refer only to amputations, which were a small minority only of the operations performed. And seeing that all operations and many injuries were liable to be followed by hospital diseases, it is easy to estimate the risks involved in entering a hospital, and to see why the field of surgery was so limited. Surgeons were literally afraid of the blind Nemesis that presided over their work. They spoke of periods of good luck as being certain to be followed by times of disaster. Operations of mere expediency—"operations of convenience"—were seldom performed. To undertake them was thought to be tempting Providence; and there was a superstition, almost amounting to a belief, that Providence did actually intervene, and that unnecessary operations were particularly liable to be followed by disaster.

With regard to the cause of hospital diseases, the state of mind of the profession was one of doubt and uncertainty. The pestilence that walketh in darkness had always been a mystery. But though hospital diseases appeared to be almost as mysterious as cholera and the plague, they offered a more hopeful field for research, because one condition—a polluted atmosphere—seemed almost essential to their existence. Nearly everyone therefore agreed that it was the air, or at all events tainted air, which somehow produced unhealthy action in wounds,—inflammation, suppuration, and all the evils that follow in their train.

Some of the most clear-sighted saw that it could not be simply the oxygen or the nitrogen in the air which did the mischief. John Hunter and Abernethy and afterwards Lister did not fail to notice that, if air entered the pleural cavity through a small wound made in the lung by a broken rib (traumatic pneumothorax), or if it became diffused through the cellular tissues of the body from a similar cause (surgical emphysema), no inflammation occurred, and no trouble followed beyond the mechanical inconvenience due to the presence of air in abnormal positions. In traumatic pneumothorax the compression of the lung might cause difficulty in

breathing, and in surgical emphysema the body might be swollen beyond recognition, but inflammation never occurred, unless, in the former case, the lung was in a septic condition, or, in the latter, an external wound was made to allow the air to escape.

The argument from these somewhat rare cases did not appeal to all; it was not insisted upon by teachers and was not therefore a matter of common knowledge. There was, however, one instructive fact which could neither be overlooked nor explained, one stumbling block for those who held that the atmosphere was solely responsible for hospital diseases:—wounds sometimes healed well in tainted atmospheres, and sometimes went wrong under apparently ideal surroundings. Still, in spite of all that could be said against it, the commonly accepted view was that the air was at the bottom of the mischief.

Opinions differed as to how the air became tainted, or whether it really was necessarily tainted at all, and still more as to the actual process that went on in unhealthy wounds. At one time some morbid action was supposed to be set up by the influence of the fixed gases, which at another was attributed to the influence of hypothetical miasms contained in the air. John Hunter, in an illuminating passage, concludes that it cannot be the former, and adds the characteristic words, "therefore there must be another cause."[1] Astley Cooper and Abernethy were equally in the dark, and no further light was thrown upon the subject during the first half of the nineteenth century.

Erichsen's book on *Hospitalism*, though published as late as 1874, reflects pretty accurately the orthodox views of surgeons before the time when Lister published his first papers on the treatment of wounds. Many of the older surgeons were then beginning to be much upset by the new views about microbes. Erichsen was amongst the number, and he was perhaps more than ever inclined to express in forcible language his adherence to the doctrines which he had always consistently held.

[1] *The Works of John Hunter*, edited by James Palmer, London, 1835-1837, vol. iii. p. 406.

He leads up to his confession of faith by two quotations from a paper by Cadge of Norwich :

" I have unwillingly and almost tremblingly proceeded to operate in the hospital, but I have had a happy confidence and a perfect assurance that in all private cases I should avoid any of these disastrous consequences." And again : " I come to the conclusion in my own mind that pyaemia, if it does not find its birth-place, does find its natural home and resting-place in hospitals ; and although a hospital may not be the mother of pyaemia, it is its nurse." [1]

Erichsen then proceeds :

" Such evidence as this, coming from a provincial surgeon of the highest standing and largest experience, is peculiarly valuable, as showing that in provincial towns there may be the same difference, so far as liability to pyaemia is concerned, in the hospital and the private practice of the same surgeon, as is found by many to exist in London.

I am acquainted with other instances of hospital infection nearly, if not quite, as serious as this ; but as they have not yet been brought before the public, I refrain from mentioning them. But surely no stronger or more conclusive evidence is needed of the tenacious and ineradicable nature of this pyaemic infection, when once it has taken firm hold of a hospital, than that which is furnished by the examples just given. What name so appropriate as ' hospitalism ' for a condition of things such as is here described ? The town free from infection ; the hospital saturated by it, to such an extent as to induce its own surgeons to recommend their patients not to enter it, to compel them to refrain from operating, and, after every attempt that science and humanity could suggest—every hygienic means employed in vain in the fruitless attempt to eradicate the pestilence from ' the very fabric itself,'—to cause the governors, as a last resource, to decide on the demolition of the building and its complete reconstruction, at a great expense, as the only remedy. The truth is that, when once a hospital has become incurably pyaemia-stricken, it is as impossible to disinfect it by any known hygienic means, as it would be to ' disinfect ' a crumbling wall of the ants that have taken possession of it, or an old cheese of the maggots which have been generated in it. There is, in these extreme cases, only one remedy left—that remedy which the Governors and Staff of the Lincoln County Hospital have so generously, so disinterestedly, so nobly resolved on—viz. the demolition of the infected fabric, and we must add the destruction of its

[1] *Lancet*, 1874, vol. i. p. 338.

materials, for that last clause must not be forgotten. In fact, just as the cattle plague has to be 'stamped out' by the pole-axe, so has the infection of a pyaemic hospital to be destroyed by the pick."

Forty years have passed since this was written, and the pole-axe, alas, is still the usual remedy for the cattle plague. But the suggestion that hospitals should be periodically razed to the ground was a counsel of despair, the impracticability of which was obvious. Ten years later no one would have thought of making it. It was however strongly supported by Sir James Simpson in a series of articles on "Hospitalism." [1] Simpson had been meditating and speaking on this subject for twenty years. He collected statistics of more than 2000 amputations performed in hospitals and more than 2000 in country practice. Their analysis seemed to show, not only that the mortality was much larger in hospitals than in private houses, but that it increased exactly in proportion to the size of the hospitals. He asserted that "the man laid on the operating-table in one of our surgical hospitals is exposed to more chances of death than the English soldier on the field of Waterloo," and after putting the question, "Why is hospitalism so dangerous to the sick?" he gives the following answer: "There exists, I think, evidence on this question, tending to show that the constitution of the surgical patient in surgical wards is liable to be endangered sometimes by the influence of morbific contagious materials from the bodies of other inmates, though the blood-poisoning which leads on to pyaemia is generally produced by the inhalation of organic and other materials which usually exist in the air of hospital wards, but which are not contagious." Simpson seriously advocated the formation of villages of small iron huts to accommodate one or two patients each, which were to be pulled down and re-erected periodically. But as he recognized that this was a scarcely attainable ideal, he suggested radical structural changes in existing hospitals, many of which were adopted. His fiery campaign, and some striking facts arising out of the experience of recent

[1] *The Works of Sir James Y. Simpson, Bart.* Edinburgh, Adam and Charles Black. 1871. Vol. ii. pp. 289-392.

wars, helped to produce a revolution in hospital construction. The pavilion system for a time replaced the corridor system. On the continent, where land is abundant and building and maintenance are lavishly provided for out of public funds, palatial institutions may be seen covering thirty acres or more of ground. They are hamlets of remotely detached wards, expensive to build, involving a very expensive service, and therefore, as Lister maintained, needlessly extravagant. Time has shown that his opinion was correct. They still stand as an outward and visible sign of the stages by which scientific thought advances, but they are no more healthy than many an old hospital that escaped the pick, but set its house in order by revolutionizing its method of treatment.

Simpson was a gynaecologist, but he took a prominent part in many discussions outside his own special branch of medicine, and in some outside the department of medicine altogether. The question of hospitalism, however, was one of special interest for obstetric physicians owing to the fearful mortality from puerperal fever in most of the large lying-in hospitals. The controversy with regard to the nature and cause of this disease had been carried on with unnecessary bitterness for twenty years or more; it was still raging, and was continued for many years to come. The storm centre was the doctrine of one of those unfortunate geniuses who happen upon a truth prematurely, but are not gifted by nature with the ability to proclaim it convincingly to the world. Many of those pioneers, whom succeeding generations glorified as heroes, have sunk under the burden of perverse misrepresentation and neglect. Such was Ignaz Phillip Semmelweis, whose sad career came to a close in Vienna in 1865, the very year we have just reached in our history. It is appropriate to consider his work here, because puerperal fever, of which Semmelweis offered the true explanation, is neither more nor less than blood poisoning occurring in connection with childbirth. It has thus a direct bearing on the confusion of thought with regard to hospitalism which we are now discussing.

Semmelweis was a Hungarian, born in Buda-Pesth in 1818. In 1846 he was assistant in the huge lying-in hospital in Vienna

to which about 7000 women were admitted annually. It consisted of two divisions. In the first the male students attended, whilst the second was reserved for the instruction of the midwives. In the latter the mortality was invariably much less than in the former—3.38 per cent. as compared with 9.92 per cent. over an average of six years (1841–1846). A ten years' average, however, gives but a faint idea of the reality. Sometimes the monthly average reached the appalling number of 25 or 30 per cent. This was indeed a heavy toll to pay for the privilege of admission, and, naturally, expecting mothers dreaded and shunned the "first division." Semmelweis was an ardent pathologist, and divided his energies between the wards and the post-mortem room, then only too well supplied with material. In the meantime he was puzzling his head over the suggested causes of puerperal fever, and the difference between the rates of mortality in the two divisions of the hospital. Some said puerperal fever was due to epidemic influences, others that it was an acute specific fever like scarlet fever or small-pox, or that it actually was the same as erysipelas. But less likely causes were suggested, such as the roughness of the male students, the modesty of the patients, the fear of death, or some unknown *materies morbi* clinging to one part of the building more than the other. "All this reduced me," he said, "to such an unhappy frame of mind as to make my life unenviable. Everywhere questions arose; everything remained without explanation; all was doubt and difficulty. Only the great number of the dead was an undoubted reality." [1]

Then one of his colleagues died of septicaemia following a poisoned wound received whilst making a post-mortem examination, and Semmelweis recognized that the disease was identical with puerperal fever and due to the same cause, infection from without—in this case infection from a dead body. "In my excited state of mind," he says, "it flashed across me with irresistible clearness that the disease of which Kolletschka had died was identical with that from which I had seen so many hundreds of lying-in women perish."

[1] *Die Aetiologie, der Begriff und die Prophylaxis des Kindbettfiebers*, Pest, Wien und Leipzig. C. A. Hartleben's Verlags-Expedition, 1861, p. 51.

His first theory, or, as he called it, "doctrine," was that infective material from a dead body was the only cause of the disease, and he at once reduced the mortality in the first division below that in the second, by insisting on careful disinfection of the hands with the best known antiseptic of the day, chlorine-water or chlorinated lime. But he very soon extended his doctrine. In its perfected form it was: that puerperal fever was caused by decomposed animal organic matter without regard to its origin, whether from the dead body or from a living person affected with a disease which produced a decomposed animal organic matter.

This was the sum and substance of his doctrine. He proved his case conclusively to impartial minds. But it was easy to throw doubts upon it. The perfunctory, but unsuccessful, carrying out of his instructions by the sceptical or the prejudiced was adduced as proof of the unsoundness of the theory on which it was based. Moreover, it was not properly put forward for ten years. Semmelweis had a rooted objection to writing ("eine mir angeborne Abneigung gegen alles, was schreiben heisst"), and no confidence in himself as an author, so he trusted for the diffusion of his discovery to the words and letters of his pupils and friends. Amongst the latter were three of the most distinguished teachers in Vienna, Rokitanski, Skoda and Hebra. They took up his cause, but unfortunately dwelt chiefly on cadaveric infection; and this led to a complete misapprehension of his views. He was ridiculed and persecuted; he was deprived of his appointment, and, in disgust, he suddenly, in 1850, left Vienna and his three friends, to try his fortunes in Buda-Pesth, his native city.

Here he had opportunities, not indeed so great as in Vienna, for carrying out his work, and here he spent the rest of his life in whole-hearted devotion to it. Thus he had already left Vienna when Lister stayed there for a fortnight on his wedding tour in 1856, and met Rokitanski, as we have seen, in rather intimate converse; but no word was said of his friend Semmelweis, or none that attracted Lister's attention.

Semmelweis at last was induced to publish. His great book—*Die Aetiologie, der Begriff und die Prophylaxis des*

Kindbettfiebers—appeared in 1861. It only increased the bitterness of his opponents. He replied to their attacks by some pungent " open letters," which did not tend to allay the strife. After four more years of this unequal struggle his mortification and indignation caused his mind to become unhinged, and it was necessary to place him under restraint. He was taken to Vienna in August, 1865, but, by a strange coincidence, died a few days afterwards of blood-poisoning following a wound in his finger inflicted in the course of his professional work.

It is a tragic story. In 1891 the world was celebrating the memory of the man who had been called the " Pesther Narr " and at whom the judicious Virchow had sneered as " Der Kerl der speculiert," whose work, though more limited than Lister's, was of the same nature, and had saved the lives of countless women in the prime of life, and who closed his book with these pathetic words :

" When I, with my present convictions, look back upon the past, I can only dispel the sadness which falls upon me by gazing at the same time into that happy future when within the lying-in hospitals, and also outside of them, throughout the whole world, only cases of self-infection will occur. . . .

But if it is not vouchsafed me to look upon that happy time with my own eyes, from which misfortune may God preserve me, the conviction that such a time must inevitably arrive sooner or later after I have passed away will cheer my dying hour."

Semmelweis was thus in two respects the forerunner of Lister. He showed that one particular form of blood-poisoning did not depend upon mysterious and unascertainable causes, but upon the contamination of abrasions and external wounds. He also proved that neither the size of hospitals, nor their age, nor their crowded wards were responsible for hospitalism, but rather the methods of hospital treatment. The amplification of his doctrine and the demonstration of the true *causa causans* followed almost immediately after his death, and was brought about by the combined labours of Lister and Pasteur. In the meantime the gynaecologists had almost forgotten the lesson they had been taught, and were obliged painfully to learn it again, as Lister's teaching diffused itself.

Long after the death of Semmelweis, and fifteen years after he had come into his own, it began to be said that he had anticipated Lister, and was the real founder of the antiseptic system. At a meeting of German naturalists and physicians in 1904, it was definitely stated by a teacher from Buda-Pesth that Lister had owned to this, and had uttered these words: "Without Semmelweis my labour would have been in vain. Modern surgery owes most to the great son of Hungary." (Ohne Semmelweis wäre mein Wirken ein Nichtiges; dem grossen Sohne Ungarns verdankt die neue Chirurgie das meiste.) Dr. Weckerling of Friedberg, Hessen, after unsuccessfully trying to verify this statement and trace it to its source, wrote to Lister asking if it was true, and received the following reply, dated September 15th, 1906:

"Although it is extremely distasteful to me to speak of the question of my priority, I cannot but answer briefly the questions you ask in your most kind letter.

When in 1865 I first applied the antiseptic principle to wounds, I had not heard the name of Semmelweis and knew nothing of his work.

When 20 years later I visited Buda-Pesth, where I was received with extraordinary kindness by the medical profession and the students, Semmelweis's name was never mentioned, having been, as it seems, as entirely forgotten in his native city as in the world at large. It was some time after this that my attention was drawn to Semmelweis and his work by Dr. Duka, a Hungarian physician practising in London.

I need hardly add that I never pronounced the sentence which you quote.

But while Semmelweis had no influence upon my work, I greatly admire his labours and rejoice that his memory will be at length duly honoured."

It must be supposed that the oblivion that had fallen upon Semmelweis's discredited discovery accounts for the fact that it was not brought to Lister's notice by such intimate gynaecological friends as Keith, Matthews Duncan, and Spencer Wells, all keenly interested in the application of antiseptics to their particular field of practice.[1]

[1] For most of the facts contained in this reference to the work of Semmelweis I am indebted to the graphic account of him by Sir William Sinclair. *Semmelweis, His Life and his Doctrine.* Manchester, At the University Press, 1909.

To summarize the matters dealt with in this chapter, it has been shown:

1. That the field of surgery was infinitely smaller in the middle of last century than it is to-day.
2. That its progress was limited by the fear of hospital diseases.
3. That these diseases were few, but that their results were disastrous.
4. That as their cause was not understood the precautions taken against them were misdirected and inadequate.

It will be our next business to review the methods of treatment then commonly in use, and perhaps in the light of after events to explain why some of them were more successful than others.

CHAPTER XI

METHODS OF WOUND TREATMENT IN THE MIDDLE OF THE NINETEENTH CENTURY

In the last chapter the general characteristics of hospital diseases have been discussed. We must now consider more particularly the wound itself, and enquire what might be expected to occur in the process of healing:—the worst that was to be feared, and the best that could be hoped for in hospital practice in the middle of the last century.

Accidental wounds are either punctured, incised, lacerated or contused. These are technical terms that require no explanation. Wounds made by the surgeon are practically always punctured or incised. As the question of surgical punctured wounds will be dealt with separately, and as surgical incised wounds are the easiest to understand and by far the more important, it is to them that attention will be first directed.

Healing of such incised wounds may take place either by what is known as "the first intention," that is, without inflammation or suppuration; or by "the second intention," that is, by the gradual filling up of the cavity with a rudimentary form of tissue known as granulations, the process being accompanied by inflammation and suppuration; or it may take place under a scab, "healing by scabbing," which is very common in the lower animals but rare in man.

Healing by first intention was not only hoped for but expected after operations performed on certain parts of the body, such as the face, which possess a specially large degree of vitality. But in other parts of the body it was altogether exceptional in hospital practice.

Healing by second intention was, however, the rule. It involved a certain amount of local and often of constitutional disturbance, which varied according to circumstances. If a large clean-cut wound was made, say for the removal of a tumour, there would develop round its edges during the first three days a certain amount of redness and more or less tenderness. At the end of this period, known as the period of granulation, pus would appear at a part of the wound left open for the purpose. Or if no such opening had been provided, distension of the wound with pus, and increased redness and tenderness, would be the result. In the meantime there was fever, the height of which depended on the nature and the amount of the infection, and upon the freedom of exit for the discharges. As fever invariably occurred, the patient was, in anticipation, put upon a low diet, ostensibly because a full diet was supposed to encourage inflammation, but really because the experience of ages had shown that the inevitable fever took away the appetite. Strange to say, the custom still prevails in many quarters, like the meaningless buttons on our coats, when the necessity for it has in great measure passed away.

After suppuration was well established, under favourable circumstances the fever abated, the wound became less painful and less red, and, as the granulations filled it up from the bottom, suppuration gradually diminished and finally stopped. The process of healing occupied weeks and months and left a scar that was sometimes wide and puckered.

Surgeons were quite satisfied with such a result, and were full of self-congratulation if anything better was achieved.

But what they feared was something very different. In spite of openings provided for drainage, the pus, with apparent perversity, might refuse to escape by them, and burrowed far and wide under the skin or amongst the muscles. This was accompanied by increase of fever, and necessitated "counter openings," so that often the original wound was the centre of a whole series of secondary incisions. When healing at last took place the patient was left more or less reduced by this serious though not necessarily fatal form of blood-poisoning.

Sometimes, however, even though the wound was not obviously progressing badly, the veins became affected and true embolic pyaemia followed, from which recovery was rare. This was most dreaded in amputations, and in other cases where bones had been subjected to surgical manipulations.

Sometimes again when all was apparently doing well a single rigor and some pain in the back would usher in an attack of erysipelas. Then the recent union would break down and the characteristic red rash would start on its travels, and pursue them undeterred by any of the vaunted remedies until the disease had exhausted itself or destroyed the patient. During an attack of erysipelas counter openings were frequently required, but, as the disease subsided, healing often took place with great rapidity.

Worst of all, however, was the appearance of the moist grey slough surrounded by an angry blush, which heralded the onset of hospital gangrene. The limits of the original wound were then lost sight of. What might be the shape or size or even the position of the scar in the event of the patient's recovery became a matter of the greatest uncertainty, because it was impossible to foresee the amount of tissue which would perish from the destructive effects of the disease and the heroic measures taken to combat it.

Turning now to accidental wounds; they only differ from those made by the surgeon inasmuch as most of them are lacerated or contused and often obviously dirty. Contusion and laceration imply the damaging of tissue and consequent loss of vitality. Wounds of this nature therefore were, and still are, more predisposed than surgical wounds to the complications that have been described. Amongst them compound fractures, *i.e.* fractures with open wounds, were one of the most fatal forms of injury.

The main principle that guided the ancients in the treatment of wounds was that Nature required assistance, and the building up of new flesh must be encouraged by "carnefying" or flesh-making materials. They had unbounded faith in all sorts of substances—one can hardly call them drugs—of which the supply was unlimited, as they were selected apparently promiscuously from every part of the animal, vegetable and

mineral kingdoms. Most of them were probably harmless though useless, but amongst them were included some of the filthiest excrementitious matters and certain balsams of undoubted antiseptic value. Now and then a surgeon arose who pinned his faith to one of the latter kind, applied it freely and constantly, and obtained startlingly excellent results. Often he kept his remedy a secret and then his secret died with him. That successful surgeons occasionally made their appearance in old days does not admit of doubt and should cause no surprise or misgivings. These were sporadic and accidental occurrences, the meaning of which it is not difficult to explain.

But we are not concerned with ancient or mediaeval history. Enquirers into this fascinating subject may read a very full and interesting résumé of it by Sir Watson Cheyne.[1] Our present aim is to describe the methods of treatment commonly employed in the middle of the nineteenth century.

It had long been recognized that Nature, if undisturbed, was after all fully competent to the task of repairing the effects of injuries. Even in mediaeval times a few surgeons, acknowledging this fact, had broken with the traditions under which they had been brought up. More recently it had been pointed out that, when the skin was uninjured, fractures healed without suppuration or obvious inflammation, no matter how severe the contusion or how extensive the subcutaneous laceration; and attention was drawn to the remarkable facts observed in pneumothorax and surgical emphysema, which had puzzled Hunter and other thoughtful observers before Lister's time. It was perfectly obvious that the presence of an open wound allowed something to enter which interfered with these beneficent natural processes, and it was presumed that this something was the air. The efforts of surgeons were accordingly directed to combating its malign influence, so that Nature might be left free to do her own perfect work as if no wound were present. But hitherto these efforts had been unsuccessful.

A most striking object lesson was afforded by the process of healing by scabbing, the description of which was postponed

[1] *Antiseptic Surgery*. London, Smith, Elder & Co. 1882. Chapters xiv., xv. and xvi.

for consideration here. In certain cases, especially of small wounds, a scab of dried blood is formed, under which healing proceeds as quietly and satisfactorily as if no wound were present. The scab seems to answer the same purpose as the unbroken skin, and even if a certain amount of discharge leaks out from beneath the edges, repair may take place with little or no local or general disturbance.

This suggested two lines of treatment.

One was simply to imitate Nature. After the sides of the wound had been approximated, no dressing was applied; a scab was allowed to form—indeed it was encouraged to form by the application of certain powders or caustics, or best of all by laying on the wound a piece of lint soaked in compound tincture of benzoin, which contained a fragrant balsam supposed by some to be identical with the Balm of Gilead.[1]

The other, which is known as the "open treatment," was specially advocated in Germany.[2] Instead of bringing the edges of the wound together, it was left quite open, the affected part being supported on a pillow which was periodically changed. A thin scab soon covered the exposed raw surface. A piece of linen placed at some distance protected the wound from flies, and more or less from atmospheric dust. This method had the incidental advantage of allowing the freest possible escape of the discharges, but it looked objectionable and involved a tedious process of healing. It was however followed by a certain amount of success.

Those who practised the open method cannot really have shared the common belief in the noxious qualities of the atmosphere. To the firm upholders of this creed a precisely opposite course commended itself. Their obvious duty was to seal their wounds hermetically; in other words, to attempt to exclude the air by some external application. This is called the "occlusion method."[3] Collodion was used for this purpose

[1] *A Sketch of the Principles and Practice of Subcutaneous Surgery*, by Wm. Adams, F.R.C.S. London, J. Churchill, 1857.

[2] Hermann Vezin, *Deutsche Klinik*. 1856, viii. 70, 79. A. Burow, *Deutsche Klinik*. 1859, xi. 207, 217; 1866, xviii. 217.

[3] Jules Guérin, *Gazette Médicale de Paris*, 2.s., xii. 730. 1844.

in America in 1848. Elsewhere, goldbeater's skin and caoutchouc met with more favour. Another way of obtaining the same end was by encasing the wound in adhesive plaister, and there were yet other devices which need not be enumerated. A few brilliant results were obtained; but this method had the fatal disadvantage—fatal in those days—that no drainage was provided. If therefore decomposition occurred, the disasters incidental to healing by second intention [1] were almost sure to follow.

Mr. Syme in his early days found this method of treatment prevailing in Edinburgh. For a time he employed it, but he saw its defects. When the strips of plaister were removed, on the third or fourth day, a collection of foetid pus was almost invariably found separating the surfaces of the wound. So, in 1825, he wrote against immediate closure, recommending that wounds should be left quite open for a few hours, and that their edges should then be approximated by stitches or plaister. He soon abandoned this plan in favour of immediate closure, with the provision of free drainage and the application of pressure to the bottom rather than the outlet of the wound. As Syme's dressing was adopted by Lister, and was probably the last septic dressing—if the term is admissible—that he employed, and that which he was actually using in 1862, his own description of it shall be given:

"This consisted of points of interrupted suture at sufficient distance from each other to afford a free outlet for discharges, and pads of folded lint applied over the bodies of the flaps but not extending to the lips of the wound, with a broad piece of lint over all, and a bandage applied so as to press the deep surfaces of the wound gently together through the medium of the pads; while the cutaneous margins were left free for the exit of the discharge, which was absorbed by the lint as it escaped. This, though at first a dry dressing, became practically a moist one, and prevented the blood or serum from drying so as to form a crust. It was left undisturbed for about four days, when union was found already pretty firm; and a similar application being afterwards repeated at intervals of two days, the discharge of pus was commonly very trifling in amount, and the cure speedily accomplished." [2]

[1] See page 144.

[2] Holmes's *System*, "Amputation," [1st ed.] 1862, iii. p. 69.

Syme's dressing purported to be a dry one, but, as Lister pointed out, it soon became a moist dressing. Robert Liston, formerly Syme's close friend, but afterwards his jealous rival, adopted the suggestion of delaying the approximation of the sides of the wound, and carried the idea to London, whither he migrated in 1834. But he modified it by applying lint soaked in water to the wound both before and after closure. He may be said to be the inventor of "water dressing," which long met with much favour in England.

In the stilted and egotistical phraseology of the day he denounces the method of occlusion. Writing in 1840 he says:

"A sort of routine practice has been long pursued in dressing wounds. They are put together without delay, and their edges having been squeezed into apposition are retained so by various means, such as sutures, plasters, compresses, and bandages. They are carefully covered up and concealed from view for a certain number of days. Then the envelopes of cotton and flannel, the compress cloths, the pledgets of healing ointment, and plasters are taken away, loaded with putrid exhalations and a profusion of bloody ill-digested, fœtid matter. A basin is forthwith held under the injured part, and the exposed and tender surface is deluged with water from a sponge, and then well squeezed and wiped. Then comes a re-application of retentive bandage, of the plaster, of the grease mixed with drying powder, all surmounted by some absorbent stuff, as charpie or tow, to soak up the discharge. This is not unaccompanied by pain, often more complained of than that attending the original injury or operation. The process is repeated day by day; the patient is kept in a state of constant excitement, and often, worn out by suffering, discharge, and hectic fever, falls a victim to the practice. . . . The system is a bad one, the applications filthy and abominable; the whole proceeding outrages nature and common sense. The wound is, as it were, put into a forcing bed; excited action, beyond what is required, is hurried on, and the consequence is, that union seldom, if ever, can or does take place. On the contrary, a suppurating surface, with profuse discharge, is formed; and a very tedious cure, if any, is obtained."[1]

Whilst recognizing that these are the words of a somewhat intemperate writer who is about to expatiate on his own improvements, this may be taken as the testimony of one who

[1] *Practical Surgery*, by Robert Liston. London, John Churchill. 3rd ed. 1840, p. 31.

had personal knowledge of the occlusion method. Liston's pupils and successors, thinking and speaking loosely, said that a water-dressing kept the part cool, whereas it is clear that the moist lint soon became warm and acted like a hot fomentation.

Attention is particularly drawn to Liston's dressing, because he was on the staff of University College Hospital, and left a strong impression upon his colleagues and successors. Water-dressing was the usual dressing when Lister was a student, and it continued in fashion at least up to 1870. A description of it may therefore be given, summarised from Erichsen's chapter on the treatment of incised wounds.[1] First he explains the surgeon's point of view by describing the preparation of the patient for an operation. He must be submitted to purgation and "an antiphlogistic regimen" to limit the inflammation, because "if this be carried beyond what is necessary for plastic effusion, suppurative action will certainly occur." The ligatures are left hanging out of the wound. Foreign bodies are removed with a piece of soft lint or a triangular bit of sponge or stream of cold water. Coaptation is made with sutures of waxed silk or wire of gold, silver, or iron, with plaister and with bandages, and then a strip of water dressing is applied to keep it cool!—or at all events as cool as possible. This was to be changed every two or three days. As a matter of fact it was changed much more frequently. Finally, there comes the usual postscript. "If union fail, or suppuration set in, remove the sutures, and apply a large soft linseed poultice; or a large warm water dressing, and keep the patient on a moderate antiphlogistic regimen."

Poultices were in fact much like water dressings. They had the merit of being comfortable at the time of application and of not obstructing, even if they did not encourage, the escape of discharges. But they were horribly septic things. Nevertheless they were very commonly used, sometimes from the first, but more often only after suppuration had become established. They were made of bread or

[1] *Science and Art of Surgery*, by John E. Erichsen. London, Walton & Maberly, 3rd ed. 1861, p. 103.

linseed meal. Dressers learned to make them as part of the regular routine, and it was a matter of pride to produce them smooth and light and as hot as could be borne, and so free from stickiness that the skin was left clean on their removal. At one London hospital, at least, the poultice was the favourite dressing far on into the eighties of the last century.

Of all the methods of moist treatment, the moistest, the cleanest and the most successful, but it must be added the most cumbrous, was that of irrigation and the water-bath. Like the others here described it was not of recent origin. Irrigation might be continuous, as when the affected part, or even the whole patient, was immersed in water which was constantly being changed; or when a gentle stream was made to trickle over the wound perpetually, from some suitable apparatus. Or it might be intermittent, as when the part was plunged for a certain portion of the twenty-four hours in the bath brought to the bedside. Discussion was brisk as to the most favourable temperature, whether hot, tepid, or cold. It was also a matter of dispute whether better results were obtained with plain water or with water to which some drug had been added. But in any of its forms there is no doubt that this method of treatment was soothing to inflamed wounds, and for those that were not inflamed it was at least as comfortable as most others. It was also markedly successful in preventing septic disease, which is not surprising, for, more than all others it favoured the removal of discharges as soon as they were formed, and thus tended to prevent reinfection. But its great defect was the difficulty of application, and the expense of the plant required for carrying it out effectually. This prevented its wide adoption in this country, but in Germany there may probably still be seen wards containing rows of large baths in which patients with running sores lie supported on sheets, eating and sleeping, day and night, and apparently enjoying themselves like fishes in a stream.

Reference has frequently been made to the importance of providing efficient drainage. Drainage tubes made of various

materials are figured in old books on surgery. But they had passed out of use. Benjamin Bell's leaden tubes were forgotten, and Chassaignac's indiarubber tubes, now so largely employed, had not yet met with general acceptance.[1] Drainage was accordingly promoted in two ways: first, by means of the ligatures, and secondly, by using a very small number of stitches.

To explain these very inadequate attempts to attain the object in view, we must pause to describe how bleeding was generally stopped, and how wounds were closed at a time so recent that many can well remember it.

The best and simplest way to stop bleeding is to tie the vessels. But there are many other ways of effecting the purpose. Such are the application of heat or cold, pressure, torsion of the vessels, or the insertion of needles beneath them, all of which, as they have no bearing on the present question, need not detain us. The use of ligatures, however, necessitated the leaving of a foreign substance in the wound, but this obvious disadvantage was thought to be counterbalanced by the greater security afforded. It continued therefore to be the usual practice in spite of the claims put forward by the advocates of the other methods.

If a large operation were in prospect, a few—perhaps four or six—catch-forceps were provided for seizing the arteries. The unlimited supply of these instruments at the present day would have seemed extravagant and useless, but it can easily be understood that the use of such a small number involved hurry and inaccuracy, an unnecessary loss of blood and imperfect arrest of haemorrhage.

The ligatures were of silk or whipcord, just as they came from the manufacturer, only prepared by drawing them, as a seamstress might, across a piece of common bees' wax. After tightening the knot one of the two ends was usually—not always—cut short, and when the operation was completed the long ends, perhaps as many as ten or twenty, were all brought

[1] *Traité pratique de la Suppuration et du Drainage chirurgical*, par E. Chassaignac. Paris, V. Masson. 1859. Vol. i. p. 152. "Les tubes à drainage que j'emploie habituellement sont des cylindres de caoutchouc vulcanisé."

out at the most dependent part of the wound. These were supposed to preserve an open track for the escape of the blood during the early stages of healing, and for pus and serum during the later stages. In due time they came away by a process of ulceration, which caused the end of the vessel to slough away, and then only the track they had formed remained. It provided very imperfect drainage. The interspaces amongst the threads became filled with clot, and the result was a solid cord rather than, as was fondly imagined, a system of capillary tubes.

Much less care was devoted to small vessels than is now the case. It was not generally thought essential to leave a dry wound, though some surgeons began to recognize the importance of doing so. More or less accumulation of blood in the wound was almost the rule. It was indeed an everyday occurrence to be obliged to open up the wound, in whole or in part, during the first few hours, in order to squeeze out clots or apply more ligatures, and at a later stage to evacuate collections of pus. It must not be forgotten that pus was never absent; it might under favourable circumstances be only trifling in amount, but the presence of septic ligatures could not fail to set up suppuration.

The expectation that drainage would be promoted by placing the stitches far apart was never realized. A common plan was to allow intervals of one and a half to two inches between them. But the edges of the wound always adhered and prevented the escape of blood or discharges between the stitches.

If he had been asked why the drainage of wounds was so important, a surgeon of that day would have replied: that experience showed the importance of preventing the separation of the sides of wounds, and that the more putrescible material was allowed to accumulate in the wound the greater was the chance that it would do harm. That is all that his knowledge would have justified him in saying; and it is enough for the present purpose. The answer is far from being a complete one, but it would be premature to discuss the other aspects of the question which have since been opened up by the study of bacteriology.

The reader is now in a position to appreciate, not by any means all, but a considerable number of the methods of treatment that were in use, and the general principles on which they were founded. He has had presented to him those with which Lister was best acquainted, and can picture to himself the young student at University College Hospital spreading his poultices and putting on his water dressings, and the Glasgow professor, confident in the superiority of his own practice, but sadly conscious of its imperfection. If he desires to make the picture more vivid he may visit the identical ward in which Lister taught and worked. It still occupies a corner beneath the shadow of the great new Infirmary, but is to be religiously transplanted, stone by stone, to the grounds of the University, there to stand as a monument *in sæcula sæculorum*. Lister speaks of the old Infirmary as a noble structure. The ward looks poor to modern eyes—a dingy workshop enough ! There Lister pondered over many things, but chiefly over the fact that the unbroken skin provided a protection that no dressing yet devised could with certainty imitate. And here he pointed out to his students that this was the greatest and most important of the outstanding surgical problems of the day. We shall soon be able to show how the problem was attacked and solved.

But before doing so certain matters must be considered which have an important bearing upon the questions discussed in this chapter.

One of these is " subcutaneous surgery," by which is meant the carrying out of a surgical operation through a hole so small—a mere puncture by preference—that no air is admitted. The simplest example is the division of a tendon. A very sharp, very narrow, and very clean knife is passed through the skin and intervening tissues down to the tendon. The knife just fits the wound, and when in position for cutting the tendon, the whole of the blade should have passed the puncture in the skin which is then completely occupied by the rounded shank. When the necessary manipulations have been carried out the knife is withdrawn, a pad of lint soaked in collodion is promptly placed over the tiny wound, firmly

secured by a bandage, and left untouched for several days. As thus performed, mishaps, though not unknown, were very rare even in times when most wounds suppurated.

Subcutaneous surgery dates back at least as far as the eighteenth century. But its field was a very limited one until Stromeyer employed it freely, about 1830, in orthopaedic work, after which the matter was energetically taken up by many well-known continental surgeons, and by William Adams amongst others in this country. Adams was an orthopaedic surgeon attached to the London Hospital. The reader may remember Lister's taking up the cudgels against him on Syme's behalf in quite early days. In 1857 he published an address delivered before the Medical Society of London[1] which attracted some attention. In this he sets out what he called "the principles of subcutaneous surgery." These were, that a wound inflicts injuries of two kinds, those due to mechanical disturbance and those resulting from exposure. The latter are far the more important—more likely to delay repair and more likely to endanger life. To eliminate them was the object of subcutaneous surgery.

By the nature of the case its application is very limited. It appeals especially to orthopaedic surgeons, one of whose functions is the correcting of deformities by operations on bones, muscles and tendons. But some of these operations involve the division of large bones, such as the upper or the lower end of the femur. Langenbeck invented small saws for osteotomy, and other surgeons suggested narrow chisels for the same purpose. A variety of operations, such as the removal of foreign bodies from joints and the opening of abscesses, were performed subcutaneously. In order to avoid the access of air, the punctures were in such cases made at some distance from the seat of operation. These were the "valvular incisions" of Abernethy. It was, of course, a stretch of the imagination to call all this subcutaneous surgery. The opening was often of considerable size, scarcely less than would be made for an ordinary surgical operation, and advocates of this method were confirmed

[1] *A Sketch of the Principles and Practice of Subcutaneous Surgery*, by William Adams, F.R.C.S. London, J. Churchill, 1857.

in their belief in its efficacy by the fact that the risk of failure increased with the length of the incision.

The importance of subcutaneous surgery in the present discussion depends upon the fact that it was founded on the same principle as underlies the occlusion method, and that of promoting healing by scabbing; and that its success supported the doctrine that air was the cause of wound infection. We know now that this was a mistake. The failures were due, not to the admission of a few bubbles of air, but to the use of dirty instruments; the successes depended upon the wiping off of dirt from the narrow instruments as they passed through a long narrow track of living tissue. But as this explanation was not suggested, loose thinkers, if forced into a corner, were obliged, in spite of overwhelming evidence to the contrary, to agree with Mr. Adams when he said: "I am decidedly of opinion that the continued exposure to the air, and chiefly to the irritating influence of the oxygen gas, is the principal cause of the primary inflammation which, as a rule, takes place in open wounds, and so frequently leads to the more serious complications of suppuration and pyaemia."

Subcutaneous surgery is still practised, but not—except by timid surgeons—when a good view of the parts is necessary or even merely advisable, or when a scar is unobjectionable; and now that it is fortified by the employment of antiseptic precautions its safety is almost absolutely secured.

It only remains to point out that the recognition of sepsis was no new thing, and that antiseptic substances had been employed from time immemorial. Let us enquire what they were and how they were used.

The word 'antiseptic' occurs in medical literature at least as far back as the middle of the eighteenth century and was sufficiently familiar to the laity to be quoted in the *Gentleman's Magazine* in 1751, where we read: "Myrrh in a watery solution is twelve times more antiseptic than sea salt." It is applied to something that is opposed to or that counteracts putrefaction. Putrefaction is a noisome process that the humblest savage cannot overlook, and which in some

form or other he must in the remotest times have attempted to overcome. To do so was the object of ancient physicians when their "wounds stunk and were corrupt"; and it was the aim of the embalmers of the dead, hazily meditating upon the resurrection of the body. The embalmers' art attained perfection because it could deal in a drastic way with a limited mass of putrescible substances. That of the surgeon was constantly foiled because too heroic measures defeated their object by destroying the living body, which moreover supplied in its juices unlimited nourishment to the enemy.

Ancient history, however, must again be passed over without further comment, our present purpose being to enumerate shortly the antiseptic substances which were in common use about the middle of the nineteenth century.

Benzoin was the chief survivor of the fragrant balsams so highly thought of in old times. Friar's Balsam or compound tincture of benzoin was in constant use as an external application to wounds. It has considerable antiseptic properties and still keeps an honoured place in the pharmacopoeia.

Alcohol was freely used, but principally abroad, either by itself or in conjunction with other things. It formed the basis of all tinctures and probably supplied the most important antiseptic element in certain lotions of which it formed a part. The Hippocratic use of oil and wine referred to in the parable of the Good Samaritan no doubt owed its efficiency to the antiseptic power of alcohol. Its preservative qualities are well known. It is extensively employed in the preparation of museum specimens, and, to a smaller extent, in that of articles of food; while its value in surgery is now more appreciated than ever.

Glycerine found favour in England, especially as an application to parts affected with hospital gangrene. It ceased to be much used after 1860.

Chlorine and its compounds, chlorinated soda and chloride of lime, were recognized as powerful antiseptics at the end of the eighteenth century. Chlorinated soda has a special interest, partly because it was the agent employed by Semmelweis in his campaign against puerperal fever, partly because

it has proved of such immense service during the present war.

Chloride of zinc was used chiefly as a caustic, but its powerful antiseptic properties were not overlooked. We shall have more to say about this substance, the merits of which were strongly advocated by Campbell De Morgan of the Middlesex Hospital.[1]

It is difficult to discover when Iodine became a popular remedy. It was only discovered in 1811, and soon afterwards Sir Humphry Davy and Gay-Lussac were disputing as to priority in determining its elemental nature. In the earlier part of last century it was applied to wounds in the form of tincture and gave good results. Then it went out of fashion, though never completely out of use. After a long period of comparative neglect it has in recent years again been brought prominently forward, and at the present day is almost the only chemical antiseptic, except alcohol, employed by a large number of British surgeons.

In 1815 the antiseptic and disinfectant properties of Coal-tar were recognised in France, and by degrees, as its various derivatives were separated, it became possible to estimate their individual share in the possession of those properties. Carbolic Acid, the most important of all, was discovered by Runge in 1834. It attracted no notice, however, till 1841, when Laurent devised a new method for its production. In 1840 creosote was used for protecting railway sleepers and ship timbers. In 1844 Dr. Bayard made a disinfecting powder containing coal tar. He was followed by Dr. Bobeuf in 1857 and Dr. Corne in 1858, who patented their powders. Corne's powder was intended to be used as a paste. The manner of its use and its effect may be gathered from the following statement: "The action of this disinfectant substance seems to arrest the work of decomposition; it keeps away the flies and prevents with certainty the production of worms."

[1] *The Origin of Cancer: considered with Reference to the Treatment of the Disease*, by Campbell De Morgan, F.R.S. London, J. Churchill, 1872, p. 81. He recommended it for its supposed power of destroying the germs of malignant disease and also for its antiseptic properties.

These early efforts were the precursors of more important discoveries. When the virtues of these various powders were being discussed, an English chemist and manufacturer named Calvert,[1] who had received his education in France, pointed out that carbolic acid had for some time been recognized in England as a powerful disinfectant, having been used as early as 1851 for the preservation of dead bodies, with success. Calvert and his partners were largely influential in inventing methods for producing carbolic acid in a sufficiently pure form for therapeutic purposes.

The French Academy instituted a serious discussion of the whole matter, canvassing especially the question whether coal tar products were disinfectants or merely deodorants. They then appointed a commission which investigated not only coal tar but many other substances. In the end they gave a somewhat uncertain sound. The great Velpeau was more than sceptical and, before long, M. Corne's powder and other similar productions seem to have dropped into disuse.

This was not the case with carbolic acid, with the introduction of which to surgical and medical practice the name of Jules Lemaire will always be associated. After serving as "pharmacien interne des hopitaux de Paris" he became a pharmaceutical chemist. He conducted a long and arduous series of investigations into the properties of carbolic acid. In 1860 he published a book on Saponified Coal-tar,[2] his attention having been attracted to this substance by the work of another pharmaceutical chemist, Le Beuf, of Bayonne. Le Beuf's memoir, which dealt with saponine and permanent emulsions, was presented to the Académie des Sciences in 1850. In 1863 Lemaire wrote another book[3] on carbolic acid, which attracted so much attention that a second edition was issued in 1865. In this he accepts the germ theory as the explanation of putrefaction. He used carbolic acid in

[1] Frederick Crace Calvert (1819-1873) studied under Chevreul. In 1846 he was appointed Professor of Chemistry at the Royal Institution, Manchester. He took up the manufacture of coal-tar products; began to manufacture carbolic acid on a small scale 1857, and started large works in 1865.

[2] *Du Coaltar saponiné*, par Jules Lemaire. Paris, 1860.

[3] *De l'acide phénique*, par Jules Lemaire. Paris, 1863, 2e éd. 1865.

different forms for a great variety of diseases, medical as well as surgical. He also employed it for hygienic purposes as a disinfectant, and for the preservation of foodstuffs and anatomical preparations. He performed a great many experiments, not however of a very high order of merit, and he speculated pretty shrewdly about the microbic origin of infective diseases and suppuration.

Lemaire's writings apparently attracted no attention in this country. Lister did not know of their existence till his attention was drawn to them in October, 1867. In France carbolic acid was in fashion for a time, but it created no revolution in treatment. It took its place amongst other drugs as an application to wounds and sores, and, before long, in Paris at all events, it was comparatively little used.

Lemaire deserves much credit for what he did, but not for all that was claimed for him in after years, when the originality of Lister's discoveries was called in question. We are not yet in a position to discuss the matter but shall return to it later.

The methods of employing these antiseptic substances varied enormously. All surgeons were supposed to accept certain fundamental axioms of wound treatment, such as the necessity of obtaining good apposition, of maintaining equable pressure and of keeping the parts as far as possible at rest. These were the "common form" of good surgery. Bearing these in mind everyone would naturally adopt one of the recognized methods of treatment such as those that have been described. But in doing so there was plenty of room for individuality to assert itself by the introduction of modifications. Of these one of the first to suggest itself would be the selection of some special substance for an external dressing, or perhaps even for continuous application to raw surfaces, if the practitioner happened to believe in irrigation or the open method of treatment. After all, something had to be put on, and constant failures and disappointment did not prevent the hope that at last a panacea might be found that would convert surgery from what seemed to be little better than a game of chance into something approaching to an exact science. It must never be forgotten that, with

perhaps two exceptions, surgeons employed antiseptic substances not in the hope of preventing the occurrence of putrefaction, but with the object of neutralizing its effects after it had developed by natural processes which it was supposed to be impossible to counteract. The two possible exceptions are Semmelweis and Lemaire. Semmelweis certainly attempted to guard against infection by applying his antiseptic to the chief means of transference of the poison, namely, the hands. Lemaire apparently had no such definite mode of attack. He worked indefinitely, but he had in his mind a more definite idea than most surgeons and pathologists of the nature of the trouble, because he had accepted the truth of the germ theory.

Without the foregoing somewhat technical discussion it would have been impossible to explain how completely Lister revolutionized the wound-treatment of his day. It is strange to think that it has now chiefly a historical value, because at the present time, in civil practice, one principle of treatment, some might say two methods, have superseded all the others.

CHAPTER XII

FERMENTATION AND PUTREFACTION

THROUGHOUT the year 1865 Lister was still working out the exact position of the abdominal aorta and the details of excision of the wrist, but his mind was chiefly occupied with the study of suppuration.

He never published the results of these investigations,[1] but they were no doubt familiar to his class, for the January examination paper contained, out of the five questions, one on active congestion, another on direct inflammation, and a third on the circumstances that determine the occurrence of suppuration.

A copy of it was sent to his father as a specimen of a printed examination paper, now used by him for the first time, and in order to draw attention to the question on suppuration, and he adds (Jan. 28th, 1866): "I am trying some more experiments with carbolic acid, etc., upon healing sores and wounds."

This first brief allusion to carbolic acid has a certain historical interest, but it is known that these experiments had been in progress for more than a year, and were connected with new facts that had come to his knowledge with regard to the nature of putrefaction.

In these days he was not a wide reader of continental scientific literature; but in 1865 his colleague, Dr. Thomas Anderson, the Professor of Chemistry, drew his attention to the work and writings of Louis Pasteur.

This celebrated French chemist was already well known in this country; his work on crystallography had been

[1] See Appendix.

recognized in the Royal Society by the award of the Rumford Medal in 1856. But this and his other scientific work had apparently escaped Lister's notice. The papers which Professor Anderson now showed him dealt with fermentation and putrefaction, and they produced a very deep impression, because he at once saw what an important bearing they might have upon the question of suppuration and wound infection.

His study of inflammation had led him to certain definite conclusions with regard to wound infection which for several years he had publicly taught:

1. That putrefaction or decomposition—which for him were then synonymous terms—caused suppuration and wound infection; and that wound infection did not occur without suppuration.

2. That decomposition was, in some unexplained way, set up by the air.

3. That the air alone—that is, the gases of the air—did not give rise to decomposition.

The position was unsatisfactory, because he was unable to explain the mysterious relationship between the atmosphere and decomposition. He knew that the commonly accepted explanation was wrong, and he saw the futility of attempting to overcome hospital diseases while this essential matter remained in doubt.

He now learned from Pasteur's writings that putrefaction was in fact a fermentation, that it was caused by the growth of minute microscopical beings which were carried far and wide by dust floating in the air, and that it was possible to free the air of this dust by filtration, or heat, or by other means.

This was a startling revelation; for, if it were true, the mystery of wound infection would be cleared up. It was indeed the air which started the mischief, but not the air itself. The air was only the vehicle which conveyed the germs of putrefaction to the wound. If it were true, he saw that successful wound treatment would no longer consist in employing antiseptic substances after putrefaction was established, as had often been done in the past, but in purifying the air before it gained access to the wound, so that putrefaction should never be allowed to take place.

As Pasteur's discoveries had been for some time before the world it may seem strange that this thought had not occurred to surgeons before. Perhaps it would not be strictly true to say that this was the case, though, if there had been any glimmerings of light they had led to no practical results. In any case it must be remembered that the question of fermentation was in the main a very technical one: of vital importance to brewers and wine-producers, but apparently far enough removed from that of wound-treatment. When at last it attracted the serious attention of scientific men it interested primarily chemists and only secondarily physiologists and botanists, and lastly, if at all, the medical profession. Busy surgeons, at all events, are not in the habit of reading abstruse chemical reviews; and physiology advances with such rapid strides that the practitioner of medicine makes no pretence to keep up with it. Lister himself was much engrossed with his own special occupation and investigations, upon each step of which he was in the habit of concentrating the whole of his attention for the time. No doubt they involved a fairly wide survey of recent physiological work, but they were not likely to entice him into the field of chemistry, and they certainly left him little time for promiscuous reading.

We, however, being bound by no such limitations, may turn aside to note the various steps that led up to Pasteur's discoveries. This it is impossible to do without going over some well-trodden ground, and referring to the not very remote period from which the scientific study of fermentation dates, and to a few of the more prominent men who have taken part in it. The object of so doing is to show the actual state of knowledge on these matters at the time when Lister began these "experiments with carbolic acid, etc., upon healing sores and wounds." It is not suggested that he was aware of a tithe of the facts now briefly to be related. It is not even suggested that they were commonly known to chemists and biologists in 1865.

From time immemorial it was common knowledge that grape juice turned into wine, that beer was made from malt,

and vinegar from wine, by similar processes. But the mysterious nature of fermentation scarcely attracted the attention of scientific men till the early part of the nineteenth century, or, if it did, was passed over by them as inexplicable.

Chemistry is, comparatively speaking, a young science. Robert Boyle in 1662 endeavoured to convince his colleagues that true knowledge could only be gained by the logical application of the principles of experiment and deduction. But he was a voice crying in the wilderness, and even the notable chemists of the eighteenth century wasted their energies in vain disputes about the number of the alchemical principles and the phlogistic theory, and it was only towards its close that they turned their attention to the complicated question of fermentation.

The founder of modern or quantitative chemistry was Lavoisier, whose brilliant career was cut short in 1794 by the guillotine of the Republic which had no use for learned men: (*la République n'a pas besoin de savants*). He was the first to make a real attempt to study fermentation scientifically. He looked upon it as a purely chemical process and was only interested in observing the chemical changes that occurred.

France produced many distinguished chemists during the early part of the nineteenth century, one of the most remarkable of whom was Gay-Lussac (1778-1850), a pupil and friend of Berthollet. It was he who made the intrepid ascent of 23,000 feet in a balloon quite alone, in order to conduct observations on magnetism and the temperature and humidity of the air. His earlier years were mostly devoted to physical research; in middle life he turned his attention to chemistry, and his late years were spent in lucrative public appointments in which his great knowledge found practical application.

In 1810 he published a series of experiments on fermentation[1] which were suggested by some remarkable facts brought to the notice of the French Government by a certain M. Appert. 'Citoyen' Appert was brought up to the business of preserving alimentary substances by the received methods,

[1] *Annales de Chimie*, 1810, lxxvi. p. 245.

such as desiccation or pickling, and "having spent 45 years in this business," he says, "I have been able to avail myself, in my process, of a number of advantages which the greater number of those persons have not possessed who have devoted themselves to the art of preserving." He was, in fact, a confectioner or food-purveyor and made no pretence of being a scientific man. His book is entitled *The Art of Preserving all Kinds of Animal and Vegetable Substances for Several Years.* It was published by order of the French Minister of the Interior in 1810, in a report of the Board of Arts and Manufactures. His process was to place the substances he wished to preserve in very carefully (*très exactement*) corked bottles, and to keep them for a longer or shorter time at the temperature of boiling water. The bottles were filled nearly full. The results were almost always, but not quite uniformly, successful. He seems in fact to have completely anticipated the modern methods of bottling fruit and vegetables.

Gay-Lussac found with surprise that grape juice thus preserved for a year fermented in a few hours if decanted into another vessel. He assumed, in consequence, that oxygen was necessary for starting the fermentation of grape juice, though he was forced to own that it might not be necessary for carrying on the process when it had once been set going, or even for starting the growth of yeast.

In stating his case he says that it has been proved incontestably by the experiments of Lavoisier, Fabroni and Thenard that, for the development of the alcoholic fermentation, it is necessary to bring together a saccharine matter and a particular ferment "de nature animale." He proceeds to say that it has been asserted that this can take place in the absence of oxygen. This argument, he points out, is based on the assumption that all living ferments are identical, a proposition which he sets out to disprove.

By a series of ingenious experiments devised for the purpose, he succeeded in satisfying himself that he was right, and in convincing his friend Thenard who was an ardent worker in the same field; and, in conclusion, he says, "Il résultera de cette proposition que le ferment du raisin n'est pas de

même nature que la levure de bière, ou plutôt qu'ils ne sont point, l'un et l'autre, dans le même état." [1]

Gay-Lassac was, however, fully aware that he had done little or nothing to clear up the mystery. He says: "La fermentation me paroît néanmoins encore une des opérations les plus mystérieuses de la chimie; surtout parce qu'elle ne s'opère que successivement, et qu'on ne conçoit pas pourquoi, lorsque le ferment et le sucre sont intimement mêlés ensemble, ils n'agissent pas l'un sur l'autre avec plus de rapidité. On seroit tenté de croire qu'elle est due en partie à un procédé galvanique, et qu'elle a quelqu'analogie avec la précipitation mutuelle des métaux." [2] The vital theory of fermentation evidently did not occur to him.

No further light was thrown upon the subject till about 1835. Pasteur was a boy of fifteen and Lister was only eight years old, when from two, or perhaps three, quarters, the discovery of the vegetable nature of yeast was given to the world.

The first to publish his observations was another distinguished French chemist, Cagniard-Latour (1777-1859). His paper was presented to the Académie des Sciences on June 12th, 1837.[3]

He was the first to call in aid the use of the microscope. He had been working, he said, for twenty-five years, at first with very imperfect instruments, but more recently with better ones by Oberhäuser [4] and Amici [5] which magnified

[1] "It will follow from this proposition that the ferment of the grape is not of the same nature as the yeast of beer, or rather that they are not by any means both of them in the same condition." *Loc. cit.* p. 246.

[2] "Nevertheless fermentation still seems to me one of the most mysterious of chemical processes; especially because it only operates gradually, and because we cannot understand why, when the ferment and the sugar are intimately mixed together, they do not act upon one another more rapidly. One would be tempted to believe that it is partly due to a galvanic process, and that it has some analogy with the mutual precipitation of metals."

[3] *Annales de Chimie et de physique*, 1838, lxviii. p. 206.

[4] Georges Oberhäuser (1798-1868). A Bavarian. He spent all his working life in Paris, where he manufactured a large number of microscopes and devised important improvements in their construction.

[5] Giovanni Battista Amici (1786-1863), Director of the Observatory at Florence. He made great improvements in the construction of reflecting telescopes, and of the microscope.

300 and 400 diameters. It is interesting to speculate whether the optical discoveries made by Lister's father had reached the ears of these eminent microscopists.

Cagniard-Latour tabulated the result of his investigations as follows:

1. Yeast is a mass of small globules which, as they can reproduce themselves, are organic and not simply a chemical substance, as was before supposed.

2. These bodies appear to belong to the vegetable kingdom and to reproduce themselves in different manners.

3. They appear only to act on a saccharine solution as long as they retain their vitality, "from which it is fair to conclude that very probably it is some effect of their vegetation which sets free the carbonic acid whilst converting the sugar into a spirituous liquor."

To these main conclusions he added three other minor propositions:

1. That yeast can develop and increase under some circumstances with great speed, even in the presence of carbonic acid, as in the brewer's vats.

2. That the manner in which it grows is different from that previously observed in the case of similar microscopic organisms.

3. That it retains its vitality even after exposure to the low temperature obtainable from solidified carbonic acid.

The slow and progressive action of a living ferment which had puzzled Gay-Lussac, no longer therefore remained a mystery, because it had been shown to depend upon the gradual growth of an organism. In referring to Gay-Lussac's difficulty he says:[1] "On peut juger maintenant combien était juste la réflexion de ce savant, si d'après mes recherches on est conduit à penser que la fermentation vineuse résulte d'un phénomène de végétation."[1]

Hitherto the chemists had had it all their own way. It was now the turn of the physiologists.

[1] "We can now see how completely this savant was justified in what he said, if in consequence of my researches we are led to believe that vinous fermentation is the result of a process of vegetation."

The first was Theodor Schwann (1810-1882), the friend and pupil of Müller; a skilful experimenter, whose reputation largely rests on his work in other departments of physiology. His investigations were carried out in ignorance of those of Cagniard-Latour. His first communication [1] was made a few months earlier than those of Cagniard-Latour, though not published till a few months later, and they were of even greater importance because they afforded the first real proof that the vegetable cells were indeed the cause of fermentation; and because they were more convincing than those of any previous observer in upsetting the teaching of those who maintained that spontaneous generation was a matter of every-day occurrence.

But, like others before and after his time, he sometimes met with failures which he frankly owned but could not account for; and this no doubt explains why the scientific world was left unconvinced by the very striking facts which he brought forward, corroborated as they were by the researches of Franz Schülze, Schroeder and other capable observers.

In the meantime the hands of the clock were put back and the advance of knowledge was delayed by the entrance into the lists of the formidable Baron von Liebig (1803-1873), whose observations and conclusions are recorded in a paper: "Sur les Phénomènes de la Fermentation et de la Putréfaction, et sur les causes qui les provoquent."

Liebig had a world-wide reputation, and his utterances were listened to as oracular. He brushed aside the arguments of Schwann and Cagniard-Latour, indeed he spoke of them rather disrespectfully. After allowing that the microscope had revealed the presence of certain globules in the deposit that takes place during saccharine fermentation, he says: "L'aspect qu'ils présentent dans ce cas a séduit certains savans à voir dans le ferment des êtres organisés vivants, des plantes ou des animalcules, qui, pour se développer,

[1] *Vörläufige Mittheilung betreffend Versuche über die Weingährung und Fäulniss*, von Dr. Th. Schwann im Berlin; *Annalen der Physik und Chemie*, 1837, xli. p. 184—originally contributed in his name to the *Gesellschaft naturforschender Freunde* in the beginning of February, 1837.

s'assimilent les élémens du sucre et les rendent comme excrémens sous forme d'acide carbonique et d'alcool; c'est de cette manière qu'ils expliquent la décomposition du sucre et l'augmentation de la masse du ferment dans la formation du moût de bière.—Cette hypothèse se détruit d'elle-même, etc." [1]

Liebig explains both fermentation and putrefaction by what he calls eremacausis (*érémacausie du grec, ἠρέμα, peu à peu, et καῦσις, combustion*). This is a species of slow combustion. By eremacausis he understood certain changes that organic substances undergo at normal or slightly raised temperatures, and which only occur in the moist state and in the presence of oxygen.

With regard to putrefaction he says: "La putréfaction est une espèce d'érémacausie qui a lieu sans le concours de l'oxigène de l'air; c'est une combustion d'un ou de plusieurs élémens de la substance organique aux dépens de son propre oxigène, ou bien de celui de l'eau, ou bien encore de l'oxigène de la matière organique et de l'eau à la fois." [2]

It is unnecessary to discuss at greater length the observations, his own and those of others, on which his speculations were based. Many of the former have been proved to be erroneous, and Liebig himself was obliged to acknowledge that there must be some connection between the process of fermentation and the organisms or organic substances which invariably accompanied it; but strangely enough, he continued to teach that it was the dead portion of the yeast and not the living which, being an extremely alterable

[1] "The appearance they present in these circumstances has induced certain savants to adopt the view that the ferment consists of organized living beings, plants or animalcules, which, in order that they may be able to develop, assimilate the elements of the sugar and give them off as excrement in the form of carbonic acid and alcohol; this is how they explain the decomposition of the sugar and the increase in the amount of the ferment during the formation of the must of beer.—This hypothesis is self-destructive, etc."—*Annales de Chimie et de physique*, 1839, lxxi. p. 187.

[2] "Putrefaction is a kind of eremacausis which takes place without the influence of atmospheric oxygen; it is a combustion of one or of many of the elements of the organic substance at the expense of its own oxygen, or possibly of that of the water, or possibly even at the expense of the oxygen of the organic matter and of the water at the same time."

organic substance, "decomposed, and in decomposing set in motion by the rupture of its own elements the molecules of the fermentative matter." [1]

Liebig's intervention had the effect of darkening counsel by casting doubts upon the arguments of those who looked upon fermentation and putrefaction as vital processes. His views, supported as they were by Helmholtz, whose name was already one to conjure with, passed into the text books, and were dealt out in due course by the ordinary teachers of medicine to successive generations of students.

Little or no advance was made before the time of Pasteur. We thus know the utmost that Lister might have been taught by Graham at University College in his student days. What Graham actually taught we do not know, but it is safe to assume that if fermentation was dealt with at all, the views of Liebig would be those presented to the class.

Louis Pasteur (1822-1895), perhaps the greatest of French chemists, was one of those rare geniuses who appear at the appointed time to collate and review the work of their predecessors, assimilating what is good, rejecting the bad, and, armed with the results of their experience, to surpass them all in originality. He was distinguished, not only by the simplicity and general excellence of his experiments, but also by the soundness of his deductions from them. But perhaps his most remarkable characteristic was the intuition with which he saw how one discovery led on to another. No doubt it is especially true in his case that, to quote his own words, "in the field of observation chance only favours the mind which is prepared"; no doubt he explored the valleys as well as the heights, but his apparently infallible instinct suggests the quaint apophthegm of Nietzsche, "in the mountains the shortest way is from summit to summit; but for that thou needest long legs."

The whole story of Pasteur's career is one of surpassing interest; but we are only concerned with what he had accomplished by 1865 and the steps by which he had passed from one discovery to another.

[1] *The Life of Pasteur*, by René Vallery-Radot. Translated by Mrs. R. L. Devonshire, 1902, vol. i. p. 105.

His father, who had served in the army and was a tanner by trade, gave him a good education, towards the close of which, in 1842, he attended the lectures of Dumas at the Sorbonne and Balard at the École Normale. For years he had been attracted to the study of chemistry, and the eloquence and enthusiasm of Dumas strengthened his desire to devote his life to its pursuit.

Like Lister's early work that of Pasteur was in the realm of pure science, but they both were led on by apparently inevitable steps to discoveries of the greatest practical importance.

Pasteur's fame was first made in connection with abstruse questions of polarization and crystallography. By applying and combining his observations in these two branches of science he was able to explain the difference between the two recognized kinds of tartaric acid, which, though having precisely the same chemical composition, showed certain differences in optical properties and crystalline form. Of these first researches it has been said that "they possessed in themselves purely theoretical interest; they were, however, masterpieces of thoroughness, induction, and power of careful observation combined with clear judgment, so that even had his career been cut short at this stage we should have had no hesitation in recognizing him as one of the most remarkable and exceptionally gifted of investigators." [1]

After clearing up some very technical physical and chemical matters arising out of the foregoing studies, the next matter which claimed his attention was fermentation.

As a French professor of chemistry, Pasteur must have been well acquainted with all that had been written on the subject, and with the confusion of thought which then existed. That he himself shared the views of his teacher, Dumas, as to the mysterious nature of the process, is shown by a note made for a lecture on fermentation a few months before he began to work at it seriously: "What does fermentation consist of? Mysterious character of fermentation. A word on lactic acid."

[1] *Pasteur*, by Percy Frankland and Mrs. Percy Frankland. "Century Science Series," Cassell & Co., 1898, p. 24.

This was in 1856. A bewildered and disappointed manufacturer of beet-root alcohol had appealed to him for help, and, in spite of the attempted dissuasion of his friends who advised him not to desert pure chemistry, he plunged into the enquiry with his customary energy and thoroughness, attacking the problem not only from the chemical point of view, but as a biologist with the aid of the microscope.

His first research was into the respective fermentability of the two kinds of tartaric acid. It led to the important discovery that, besides the differences in polarization and crystallization, these two acids were utterly different from a physiological point of view; for, while one kind is taken up and transformed by the organisms that bring about fermentation, the other resists their attacks or forms an unsuitable pabulum for them.

He then studied the well-known varieties of fermentation in succession. By showing that the yeast plant assumes different shapes at different stages in the fermentation of wine, he demolished the teaching of Liebig which had held the field for so many years. He recognized for the first time the presence of a micro-organism in connection with the process of lactic acid fermentation. He explained what before was obscure in connection with the manufacture of vinegar. He showed that fermentation could be set up by the addition of minute cultivations of the special organism connected with each particular process. Finally he prepared a fluid consisting of a solution of sugar to which only mineral substances had been added, in which he could at will produce either the alcoholic or the lactic fermentation by inoculating it with the appropriate organism.

But this was not all. In the course of his investigations, he had discovered the possibility of anaërobic life; that is, that there are certain organisms which grow, not in the presence of air, but only in its absence. Such is the case with the organism which he described as associated with the butyric fermentation. He afterwards extended these observations and demonstrated that the butyric ferment is not an isolated example, but that there is a whole class of organisms which though they cannot indeed do without oxygen, are unable to

flourish in the presence of free oxygen. They obtain their oxygen from the compounds of little stability which they decompose. This observation was one of immense importance, which has been largely used in subsequent researches. It led Pasteur to the study of putrefaction and to the development of a new theory of fermentation and decay. In this connection he added conclusive proofs of the accuracy of the observations of Schwann and others, and cleared up some of the apparent inconsistencies which they had left unexplained. He also finally settled the point that putrefaction does not occur independently of the agency of micro-organisms.

Of all Pasteur's discoveries none impressed Lister more than his demonstration that the organisms which produce fermentation and putrefaction are carried on particles of dust floating in the atmosphere, and that these particles of dust can be destroyed by heat, or filtered off by cotton wool, or intercepted in the finely drawn-out, or tortuous, necks of flasks, through which free ingress and egress of air take place owing to the diurnal variations in temperature. Hardly less interesting was the proof that these particles of dust are more abundant in some places than in others; for example, that, while plentiful in dusty rooms, they are absent in undisturbed cellars and on mountain tops. As the air had always been looked upon as the cause of putrefaction, the discovery that its morbific property was due to the presence of filtrable dust seemed to suggest that the atmosphere was the only vehicle of mischief. This, of course, is not the case; and it did not escape such an acute observer as Pasteur that germs not only people the air but are carried by it to all solid and liquid substances, and therefore will be found adherent to the hands of the experimenter, to the insides of bottles, to corks and even to such unlikely materials as mercury, through which some were in the habit of passing their sterilized putrescible fluids and purified air.

Another point of almost equal importance for Lister was definitely proved in the course of these observations. Pasteur showed more clearly than any of his predecessors that certain natural substances, such as blood and urine, are free from micro-organisms, and can be kept from decomposing for an

indefinite length of time if received with proper precautions into previously sterilized vessels.

Intimately connected with these questions was that of spontaneous generation, which had been a subject of much bitter controversy in the past. Contradictory results obtained by different observers, or, as often was the case, by the same observer, had left the matter in a state of great uncertainty, and in spite of its engrossing interest for philosophers and the general public, scientific men seemed to despair of the possibility of reaching a definite conclusion regarding it. The embers of strife were again blown into a flame by the appearance, in 1858, of Dr. Pouchet, Director of the Natural History Museum at Rouen, with apparently convincing experiments showing that organisms were developed spontaneously when hay which had previously been heated to a high temperature was introduced into an atmosphere of pure oxygen. In 1860 the French Academy offered a prize for a series of experiments that would throw light upon the subject. Pasteur's study of the lower forms of life had led him to conclusions directly opposite to those of Pouchet. He entered into the contest with eagerness, again disregarding the advice of his more prudent friends, and, after conducting with infinite labour an enormous number of simple but conclusive experiments, he convinced the Academy that "spontaneous generation is a chimera." This verdict, which was delivered in 1862, coming from so high an authority, was generally accepted, or was only disputed in a half-hearted manner, until the question was again raised by Dr. Bastian in 1876.

An idea of the enthusiasm with which Pasteur conducted his work and of the happy phraseology in which he announced its results, indeed some appreciation of the man himself, may be gathered from the following sentence in a speech on "spontaneous generation," delivered at the Sorbonne on April 7th, 1864. It was a momentous occasion: all Paris was there: it was the most important audience that had ever come together to hear him.

"And therefore, gentlemen, I could point to that liquid and say to you, I have taken my drop of water from the immensity of creation, and I have taken it full of the elements appropriate to the

development of inferior beings. And I wait, I watch, I question it, begging it to recommence for me the beautiful spectacle of the first creation. But it is dumb, dumb since these experiments were begun several years ago; it is dumb because I have kept it from the only thing man cannot produce, from the germs which float in the air, from Life, for Life is a germ and a germ is Life. Never will the doctrine of spontaneous generation recover from the mortal blow of this simple experiment." [1]

And if this was his way of describing what he had done, it is equally interesting to hear what he looked forward to. In 1863 Napoleon III. visited the small laboratory of the savant who had recently been elected to the Academy. "I assured the Emperor," he said, "that all my ambition was to arrive at a knowledge of the causes of putrid and contagious diseases."

Let us now recapitulate the points of special interest to Lister to be found in Pasteur's writings before 1865, and which it may well be imagined came to him as a light shining in a dark place:

Putrefaction is a species of fermentation.

It is caused by the growth of micro-organisms and does not occur independently of their presence.

The micro-organisms that produce fermentation and putrefaction are carried by the air on the dust that floats in it. They also occur on and in solid and liquid substances.

These micro-organisms can be destroyed by heat and other agencies or separated from the air by filtration.

Certain recognizable organisms produce definite and distinct fermentative processes.

All of these organisms require oxygen. Some of them flourish only in the presence of free oxygen (aërobic), others only in its absence (anaërobic). The latter acquire their oxygen from the bodies which, by their growth, they are causing to ferment and putrefy.

Many natural animal and vegetable products have no tendency to ferment or putrefy, even in the presence

[1] *The Life of Pasteur*, by René Vallery-Radot. Translated by Mrs. R. L. Devonshire, 1902, vol. i. p. 142.

of oxygen, if collected with proper precautions and kept in sterilized vessels.

Spontaneous generation has never been observed to occur and thus may be regarded as a chimera.

It is possible thus to epitomize what was known of these very complicated subjects by chemical and physiological experts at the time, but this alone will not enable us to appreciate Lister's mental outlook with regard to them in 1865. In order to do so we must remember that the science of bacteriology had scarcely come into existence, and think of the extraordinary advance of knowledge with regard to the number and life-history of pyogenic micro-organisms. Lister's simple creed, founded on Pasteur's teaching, and which, for the moment, he held with profound conviction, was that vibrios (that is, micro-organisms) caused putrefaction and that they peopled the air in overwhelming numbers. He could not have guessed that many different organisms had the power of producing decomposition; probably he thought that one only was engaged in the process, just as one was known to cause the lactic and another the butyric fermentation. He had no suspicion that micro-organisms had any other means of access to the living body than through open wounds; and many other fundamental matters now known to us were hidden from him. Unless we take all this into account it will be difficult to follow the progress of his discoveries with rational appreciation.

CHAPTER XIII

THE ANTISEPTIC SYSTEM
(1865-1867)

LISTER'S campaign against wound infection and hospital diseases was begun in 1865, but the contest had long been looked forward to if not actually planned.

In the early Edinburgh days he clearly had it in mind if we may believe the testimony of Sir John Batty Tuke, who, writing long afterwards, on March 14th, 1907, says:

"DEAR LORD LISTER,

Let me thank you most warmly for the book received yesterday. The reading of it was like looking back through a long vista of fifty years. How it revived the memory of the step by step process you employed till you reached the great conclusion.

Did I ever tell you of my recollection of you in 1854 (or 1855) when extending, to your dictation, Mr. Syme's lectures one night late, you somewhat suddenly said, 'Let us go and look at that popliteal case.' You took down the dressing, and found the wound healed except where the ligature was. You said, 'The main object of my life is to find out how to procure this result in all wounds. But why is it not healed around the ligature?' Boy-like I said, 'The irritation of the silk.' 'No,' you replied, 'not of, but *in* or *on*.'"

Lister said that he had no recollection of this incident; but it can hardly have been a pure invention. Moreover, the evidence of Glasgow students of the early sixties points strongly in the same direction. One of them tells of a certain occasion when Lister was examining a contused and comminuted fracture with unbroken skin, which was certain to do well as long as the skin remained unbroken, but sure to end disastrously if ever the skin gave way, and pointed out

to his class that anyone who should explain this difference and enable an open wound to behave like a closed one would be among the greatest benefactors of his age. Perhaps he already had a hope that this privilege would be his.

His physiological and pathological studies had been leading up, one after the other, to the struggle, by giving him very definite views about inflammation. And now that the purely technical work which had occupied so much of his time was disposed of, he was still further preparing the ground by observations and experiments on suppuration in general and the suppuration of blood clot in particular.

In the unhealthy wards at the Glasgow Infirmary he had endless opportunities of studying suppuration, not only the pathological process by which normal tissues, muscle, fat, bone, or whatever it may be, are converted into pus—a question rather of scientific than practical interest; but also the broader question, why suppuration occurs in wounds at all.

This was a matter of vital—or rather deadly—importance for patients as well as surgeons, because it appeared to be only when wounds suppurated that there was a risk of their being followed by hospital diseases.[1]

About the year 1861 Lister began to teach publicly in Glasgow that "the occurrence of suppuration in a wound under ordinary circumstances, and its continuance on a healthy granulating sore treated with water dressing, are determined simply by the influence of decomposition." And now that the true nature of decomposition was for the first time revealed to him by Pasteur he saw that this was the key to the situation. The cause of decomposition being known and the means of preventing its occurrence in the laboratory having been discovered, it was clear that similar means ought to prove effectual in preventing decomposition in wounds, in which case suppuration would be done away with, and hospital diseases would be banished at the same time.

This was the principle upon which his Antiseptic System of surgery was based. It is to the gradual development of

[1] To this general statement some exception must be made as regards erysipelas.

this revolution in surgical treatment that we must now turn our attention.

What is meant by the antiseptic system is best summed up in Lister's own words: [1]

"In the course of an extended investigation into the nature of inflammation, and the healthy and morbid conditions of the blood in relation to it, I arrived, several years ago, at the conclusion that the essential cause of suppuration in wounds is decomposition, brought about by the influence of the atmosphere upon blood or serum retained within them, and, in the case of contused wounds, upon portions of tissue destroyed by the violence of the injury.

To prevent the occurrence of suppuration, with all its attendant risks, was an object manifestly desirable; but till lately apparently unattainable, since it seemed hopeless to attempt to exclude the oxygen, which was universally regarded as the agent by which putrefaction was effected. But when it had been shown by the researches of Pasteur that the septic property of the atmosphere depended, not on the oxygen or any gaseous constituent, but on minute organisms suspended in it, which owed their energy to their vitality, it occurred to me that decomposition in the injured part might be avoided without excluding the air, by applying as a dressing some material capable of destroying the life of the floating particles.

Upon this principle I have based a practice of which I will now attempt to give a short account."

This was not, as the word antiseptic may seem to imply, the old struggle against putrefaction already established in a wound: a struggle which had gone on since the earliest days of surgery. It was an effort to prevent the occurrence of putrefaction in wounds at all. It was an endeavour to introduce a completely new system of surgery by eliminating decomposition altogether, that is, a true aseptic surgery; and if he had, from the first, adopted the word aseptic which appears more closely to connote his principle than the word antiseptic, some misunderstandings of later years could never have arisen.

The matter may perhaps be made clearer by stating it in different and simpler words. It had been shown that blood and flesh, if sterile to start with, could be kept from

[1] *British Medical Journal*, 1867, vol. ii. p. 246. *Collected Papers*, vol. ii. p. 37.

putrefying in a glass bottle which had been sterilized, provided that its neck was hermetically sealed, or the air admitted to it had been filtered, heated, or submitted to the action of an antiseptic chemical substance. But if the bottle was broken or if the cork was removed, and unfiltered, unheated, or untreated air was admitted, putrefaction infallibly occurred.

The skin is the bottle in which our putrescible bodies are contained: a delicate covering almost as flimsy as glass. Let it be lacerated or cut and immediately a contest begins between our defensive living tissues and the deadly germs carried to it by the air, unless the air thus admitted be either filtered, heated, or submitted to the action of an antiseptic chemical substance.

This explains the difference in the behaviour of simple and compound fractures. The simple fracture is like one of the confectioner Appert's bottles, "très exactement bouchée"; the skin is uninjured and the extravasated blood and the damaged tissues, thus protected, undergo no putrefactive changes, while healing goes quietly on by peaceful natural processes. Not so in the compound fracture; here the skin is torn; the bottle is broken, or the cork is removed, and in a few hours decomposition sets in.

Possibly the close resemblance between these two experiments, one performed in the laboratory with dead material, one demonstrated by Nature on the living body, made Lister apply the principle which he had discovered first to the treatment of compound fractures. Or it may have been because compound fractures were especially common in Glasgow and because, all the world over, they caused a large proportion of the deaths from hospital diseases. No doubt he saw from the first its general application; but for a time he left untouched the more simple question of the treatment of abscesses, and incised wounds made by the surgeon, and turned to the more difficult, because more complicated, one of accidental injuries.

It is more difficult to apply the principle to compound fractures because the damage has almost always been inflicted some time before they are seen by the surgeon, and in the interval they have become infected. Moreover, they are

mostly the result of machinery or railway accidents or other injuries that involve the introduction of foreign bodies and dirt into the wound.

Lister at first paid most attention to the air as the source of infection, although he was well aware that the wounds were infected, just as he knew that his own hands were infected, by something more deadly than mere atmospheric dust; and he recognized that, before proceeding to render aseptic the air which would subsequently be admitted, his first duty was to destroy the germs already in the wound; and that it was equally important to purify his hands and instruments and any other material likely to come in contact with the injured surface. For it was obvious that all these had been exposed to the contamination of the air as much as or even more than the wound itself.

Of the three methods available for ridding the air of its germs:—heat, filtration, and treatment by a chemical antiseptic, he chose the last, as the other two did not, at the moment, appear to be practically applicable. And looking round for a suitable antiseptic, he remembered that he had heard of the way in which carbolic acid had been used as a disinfectant in dealing with the sewage at Carlisle, and the striking results which had been obtained.

His colleague, Dr. Thomas Anderson, supplied him with a sample of the crude acid, known in the trade as German creosote:—a malodorous fluid, dark from tarry impurity. On the physical properties of this substance he proceeded to make his own observations, and with it he carried out his experimental treatment of compound fractures in the following way.

After cleansing the broken limb and squeezing out as far as possible all clots of blood, a piece of calico or lint soaked in undiluted carbolic acid, and held by a pair of forceps, was introduced into the wound and passed freely in all directions, in order to destroy the germs that had entered either at the time of the accident or afterwards, and might be lurking in deeper parts. A piece of lint, similarly soaked in the acid, was then applied to the wound, just large enough to overlap it in every direction by half an inch. This was

covered by a slightly larger piece of thin block tin or sheet lead, the object of which was to prevent the evaporation of the antiseptic. The dressing was then fixed in position by strips of adhesive plaister, and some suitable absorbent material was packed round between the limb and the splints for the purpose of soaking up any blood or discharges that might escape. The blood and carbolic acid soon formed a tenacious crust or thick paste which was not removed for several days, but its antiseptic properties were renewed from time to time by painting some more of the undiluted carbolic acid on its outer surface, after removing the metallic plate for the purpose.

This limited dressing was, as he said, something like the crust that is formed in "healing by scabbing"—Nature's surgery—the imitation of which John Hunter so strongly advocated. It possessed, in addition, most of the essential characters of all the antiseptic dressings Lister subsequently introduced. He insisted that the ideal dressing should be mild and unirritating, and that it should contain a store of the antiseptic sufficiently potent and in such a form that it could not be easily or rapidly removed by the discharges. Thus it would exercise a continuous influence upon these discharges and render them incapable of supporting the life of any microbes which might gain access to them when they had passed beyond the limits of the dressing.

Very soon, however, the defects of this primitive dressing became apparent. Chief amongst them was the fact that the undiluted carbolic acid was far from being unirritating. It caused superficial sloughing or death of the tissues with which it came in contact; and when the wound was large and an extensive dressing was required, a most undesirable destruction of skin was the result. He therefore turned his attention to devising something better adapted to the purpose. The crude carbolic acid was almost insoluble in water. He now obtained a purer sample, which was supplied, either in the liquid form or in almost colourless crystals with a not unpleasant—he calls it an "almost fragrant"—smell. This was soluble in 20 parts of water, and, almost to any extent, in oil. The watery solution served as a lotion, which could be made of any desired strength (less

than 1 in 20); while the solution in oil seemed likely to provide a suitable dressing.

Water holds carbolic acid but feebly, and yields it up readily to substances for which it has a greater attraction. But oil holds it very firmly. Thus a strong oily solution has a milder action on the tissues than a dilute watery solution. Oil readily removes the carbolic acid from a watery solution, but carbolized oil gives up very little of the acid to water that is brought into contact with it.

The discharges from a wound may roughly be compared to water. As they pass under, or through, an oily dressing, they rob it of its carbolic acid very slowly, but yet in sufficient quantity to acquire antiseptic properties of their own. An oily dressing would thus contain a reservoir or store of carbolic acid sufficient to last for a longer or shorter time according to the amount of the discharge, and thus render unnecessary the periodical reinforcement which was required in the primitive dressing. The watery solution, on the other hand, would serve for the rapid disinfection of wounds or skin or other contaminated materials.

The first oily dressing was simply lint soaked in carbolized oil, which, though effective enough, was found to have many disadvantages.

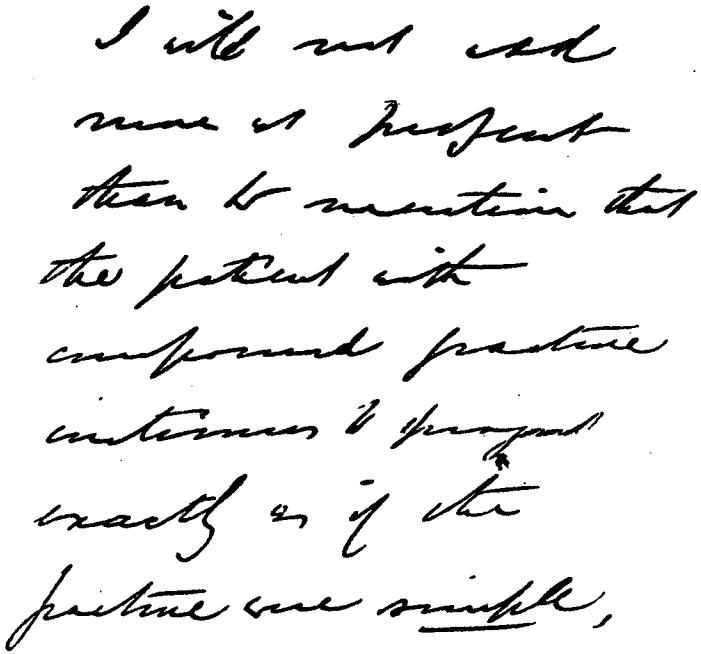
The second, arrived at after many experiments and disappointments, consisted of putty made of common whitening (carbonate of lime) and a solution of carbolic acid in linseed oil (1 in 4, or 1 in 6).

As long as the undiluted acid alone was used, its application was but limited. It is a caustic, and, in the primitive dressing, it excoriated the skin and made the living tissues suppurate. The putty, which was spread a quarter of an inch thick on block tin or tinfoil, resembled a poultice. It did not irritate the skin and the living tissues. There was therefore no limit to the possible size of the dressings; and the discharges could be made to travel as far as it was desired before they could possibly be infected by the dust of the air.

Although the first occasion on which he used carbolic acid in the treatment of a compound fracture was in March, 1865,

LISTER'S HANDWRITING.

Part of a letter to his father, 1st June, 1866, describing the progress of the first successful application of the antiseptic treatment to a compound fracture.


I will not end
now as I suspect
there is mention that
the patient with
compound fracture
continues to progress
exactly as if the
fracture was simple,

i.e as if there were
no wound, and 12
days have now elapsed
since the accident.
If the case continues
to do well to a cure, I
certainly hope to
publish it, as it would,
in that case, sufficiently
prove in itself that the
new mode of treatment
is valuable
With our united dear
Love to all
I remain
Very ever affect^te son
Joseph Lister

there was, owing to an unusual dearth of such accidents during the remainder of the year, no opportunity of a good test case for the application of the principle till the spring of 1866. About this he wrote to his father on May 27th, "There is one of my cases at the Infirmary which I am sure will interest thee. It is one of compound fracture of the leg: with a wound of considerable size and accompanied by great bruising, and great effusion of blood into the substance of the limb causing great swelling. Though hardly expecting success, I tried the application of carbolic acid to the wound, to prevent decomposition of the blood, and so avoid the fearful mischief of suppuration throughout the limb. Well, it is now 8 days since the accident, and the patient has been going on exactly as if there were no external wound, that is as if the fracture were a simple one. His appetite, sleep, etc., good, and the limb daily diminishing in size, while there is no appearance whatever of any matter forming. Thus a most dangerous accident seems to have been entirely deprived of its dangerous element."

There are other references in his letters to this case, to the excitement it caused, and to the surprise. Thus on June 3rd, he writes, "The great swelling has now almost entirely subsided and the limb is becoming firm. And, what I really could not have expected, the original crust of clotted blood, lint and carbolic acid which was over the wound the day after the accident still remains there without a drop of matter (pus) having as yet formed beneath it."

In fact, the result was so startling that he contemplated publishing this case at once. But others followed in quick succession, each suggesting modifications in treatment or supplying new pathological facts. Moreover, as in October he began to apply the treatment to abscesses, the idea of recording a single case was given up; and, by the end of the year he was contemplating writing a book on the subject.

Lister never in his life wrote a book. It is difficult to think of his undertaking such a task. The amount of time spent upon each one of his individual papers cannot be guessed from the easy flow of his language. He painfully considered the exact meaning of every word, and would have found the

compilation of a volume insufferably burdensome. At last it was decided to publish his observations in the form of a series of articles in the *Lancet*, and to include in it a reference to the treatment of abscesses.

As a scientific experiment the treatment of abscesses was more intelligible and more convincing; as a practical surgical procedure it was more striking because it gave results absolutely new and uniformly successful. Referring to the part of the paper dealing with this subject, Lister says in a letter to his father (Feb. 24th, 1867), "Meanwhile I almost long to be writing it, as it promises to be at least as satisfactory as Part I, and very likely as long. Cases to illustrate it are now accumulating, and hardly a day passes without some new fact turning up regarding it."

In treating an abscess the problem was comparatively simple. He had to open the abscess—so to say, to uncork the bottle full of putrescible material—and to keep its contents from decomposing in spite of the admission of air.

The plan adopted was to place a piece of lint soaked in carbolized oil (1 part in 4) over the part to be operated upon for some time before the abscess was opened. This purified the surrounding skin. The knife was dipped in the same oily solution, and, when the incision was made, the matter was allowed to flow away beneath the protecting veil of oiled lint. Thus, if any air were sucked back, it was brought under the influence of the carbolic acid, by which its germs were destroyed, just as in Schwann's or Pasteur's experiments with bottles they were destroyed by heat or separated by filtration. The putty dressing was then applied and changed as occasion required.

Most of the abscesses thus treated were chronic abscesses connected with disease of the spine or other bones, at that time a most unsatisfactory and often fatal class of cases. The results were such as had never been obtained before.

This is a strong statement but it is nevertheless true. Lister was deeply impressed by the success of the treatment. In the letter last quoted from, he says:

"There are two patients now in the hospital rapidly gaining flesh and strength who, without this plan, would very probably have

died, and another left a few days since for the Convalescent Home, quite healed, of whom the same may be said. The course run by cases of abscess treated in this way is so *beautifully* in harmony with the theory of the whole subject of suppuration, and besides the treatment is now rendered so simple and easy for *any* one to put in practice, that it really charms me. I have been sometimes thinking lately that I could not have been working thus had I been at Univ^{y}. College, and that I am probably employed here much more usefully, though more quietly."

Again on March 17th, 1867, he wrote:

"I have just now some most interesting cases on hand; cases of disease of bone which have gone on to suppuration. One is a boy five years old with disease of the spine with an abscess of enormous size reaching from the umbilicus to the middle of the thigh. To have opened this in the usual way would have been probably to kill the little fellow in a day or two from irritation by the decomposition of the discharge, the acrid fetid pus acting upon so large a surface as the wall of such an abscess. Or if death had not occurred so soon, there would certainly have been a *profuse* purulent discharge that would before long in all probability wear the patient out. Well, I opened it on the new plan 4 days ago, taking out just a pound of pus, and to-day the whole discharge of 28 hours was three quarters of a drachm, quite odourless, and almost transparent!

The other case is one in which a boy's ankle joint has suppurated. I opened it 3 days ago and got an ounce of pus from it. Had I not used the carbolic acid, there must have been a copious discharge of fetid pus, and probably the ankle would have been powerfully irritated by it, very likely necessitating amputation. To-day, however, the ankle is perfectly free from pain or disturbance, and all I could get out of it was a little clear liquid (*no* pus) perhaps two drops: and not more than that amount had escaped into the dressings!"

Even to-day we sometimes see abscesses connected with disease of the spine which have burst spontaneously or which have been allowed to "go wrong," a common but most objectionable phrase which is used to slur over failure to prevent decomposition. The patients then pass into a septic state, with sinuses discharging for months or years, as a result of which they often die. But the sting seems to have been taken out of septic suppuration by all the modern improvements in sanitary and hygienic arrangements.

Moreover there are fresh-air sanatoria and other special means of treatment formerly unknown. The result is that such cases do not die so quickly or so invariably as is suggested in the letters quoted above. In the middle of last century to open one of these large abscesses was almost certainly to sign the patient's death warrant. The evil day was therefore put off as long as possible, regardless of the fact that the larger the abscess became the more extensive was the surface to absorb the poisonous products of decomposition whenever they were admitted.

Under the carbolized putty dressing, when once the matter filling the abscess had escaped, no more real pus was formed, because, as Lister showed, the granulations forming the walls of an abscess do not suppurate unless they are irritated in some way. The reason why the granulations suppurate when an abscess of this kind is opened without antiseptic precautions is because the micro-organisms, by setting up decomposition of the pus, make it intensely irritating.[1] Under the new treatment nothing irritating was introduced; there was no need to treat the interior with carbolic acid because there was nothing to destroy. Nothing could enter the cavity of the abscess except bland, because purified, air. For years afterwards many who had not seen Lister's practice or obtained similar results themselves positively did not believe that his account of it could be accurate. They had been accustomed to see the opening of such an abscess followed in a day or two by a profuse and evil-smelling discharge, instead of which under the new treatment they were told that only a small quantity of inodorous clear serum, perhaps only a few drops, escaped at each changing of the dressing. They had been accustomed to see the patient pass at once into a hectic state, from which he was too often only relieved by death. Under the new treatment they heard instead of a gradual improvement in general health, while case after case was brought to a successful conclusion. It was perhaps naturally thought that Lister's enthusiasm had made him forget failures and exaggerate successes.

[1] I use here the language of 1867 not of 1917.

The epoch-making paper, which recorded Lister's first observations on the antiseptic system of surgery, appeared in the *Lancet* between March and July, 1867. It bore the title, "On a New Method of treating Compound Fracture, Abscess, Etc., with Observations on the Conditions of Suppuration." His scrupulous attention to phraseology is shown by the fact that he was in great doubt whether to use the word "conditions" or "causes," and discussed the matter with his father at some length.

The paper is divided into two sections; or rather there is a main portion dealing with compound fractures followed by a short preliminary note on the treatment of abscesses. His father had suggested that he might be giving undue prominence to the subject of compound fractures and so divert the reader's attention from the underlying principle. But Lister thought that his original plan of dividing the paper into three parts—1, compound fracture; 2, abscesses; 3, suppuration—would prevent this. As a matter of fact, even the first portion was not completed when publication began, and, as it was gradually evolved, the intention of dividing the paper into three sections was abandoned.

The part treating of compound fracture, after a preliminary statement of the principle, and a generous acknowledgment of the "flood of light that has been thrown upon this most important subject by the philosophic researches of M. Pasteur," consists of an accurate description of eleven cases, four of which occurred in the practice of his colleagues. As they follow in succession the reader is brought face to face with the difficulties as they arose, he is shown how they were overcome, and the way in which apparent contradictions were explained. In fact, as Lister said, this method had the advantage of bringing the subject out in the same sort of way as it had been worked out by himself.

To the surgeon of to-day the paper is full of interest. He can to some extent appreciate the thought, the experiments at home and at the Infirmary, and the anxieties which were associated with the earliest days of the development of this embryo of modern surgery. He may even marvel that Lister's faith was strong enough to bring him through; but

that is only because he cannot place himself, even in thought, in the same position. For, out of the eleven cases, two had been affected with hospital gangrene and one had died of haemorrhage four months after the accident, which explains Lister's saying, " I have had *some* rather sorrowful experience in bringing the method of treatment to a trustworthy state." " But," he adds in a hopeful vein, " this I really think I have now most satisfactorily done."

The result was that only one of the eleven cases had died, though one had lost his limb. To have obtained nine successes out of eleven consecutive cases in any hospital practice was an event of the first importance, and this was rendered all the more impressive because it had taken place in the notoriously unhealthy wards of the Glasgow Royal Infirmary. Naturally it quickly attracted the attention of the medical world.

Many new pathological facts came to light in the course of the investigations which formed the material for this paper. Of these the most important were:

1. That an antiseptic clot which had once contained carbolic acid could, if undisturbed, be organized into living tissue by the growth into its substance of cells and vessels from surrounding parts.

2. That a piece of bone that has died may be absorbed in an aseptic wound by the granulations that lie in contact with it.

These two discoveries had such important bearings upon the development of the antiseptic treatment, and are such good illustrations of Lister's habit of keen observation, that they shall be described in his own words.

In speaking of his third case of compound fracture treated antiseptically, he wrote:

" On the 7th of June, nearly three weeks after the accident, an observation of much interest was made. I was detaching a portion of the adherent crust from the surface of the vascular structure into which the extravasated blood beneath had been converted by the process of organization, when I exposed a little spherical cavity about as big as a pea, containing brown serum, forming a sort of pocket in the living tissues, which, when scraped with the edge of a knife, bled even at the very margin of the cavity. This appearance showed that the deeper portions of the crust itself had been converted

into living tissue. For cavities formed during the process of aggregation, like those with clear liquid contents in a Gruyère cheese, occur in the grumous mass which results from the action of carbolic acid upon blood; and that which I had exposed had evidently been one of these, though its walls were now alive and vascular. Thus the blood which had been acted upon by carbolic acid, though greatly altered in physical characters, and doubtless chemically also, had not been rendered unsuitable for serving as pabulum for the growing element of the new tissue in its vicinity. The knowledge of this fact is of importance; as it shows that, should circumstances appear to demand it, we may introduce carbolic acid deeply among the blood extravasated in a limb, confident that all will nevertheless be removed by absorption. A few days later all traces of the little cavity had become obliterated by the granulating process." [1]

In describing the next case he made the following observation:

"Not only had the compound of blood and carbolic acid which had existed in the depths of the wound been organized, but the portions of tissue killed by the violence to which they had been subjected in the accident, and also those destroyed by the caustic action of the carbolic acid, had been similarly acted on, and all had been, so to speak, fused together into a living mass, without the occurrence of any deep-seated suppuration."

This was remarkable enough, but the actual observation of the absorption of a piece of dead bone was more striking because the impossibility of such an occurrence was commonly taught.

The description of it occurs in the account of the case of Charlie F., a boy who was run over by an omnibus and who must have been a favourite, as he is often mentioned in Lister's letters.

"The explanation of this satisfactory state of things was afforded by an observation of much interest made at this period. Since the removal of the crust the granulations had been growing up on all sides about the bone, so that the bare part of the upper fragment was almost entirely covered in, and even the lower fragment, which projected beyond the level of the upper, was to a great extent embedded in the new growth. It had been noticed before the end of this fragment was so much covered up, that granulations were sprouting from the medullary canal, showing that the bone was not

[1] *Collected Papers*, vol. ii. p. 8.

dead in its entire thickness. Nevertheless, as the superficial parts had certainly lost their vitality, I had not doubted that a thin layer at least must exfoliate from the whole. Now, however, I observed that some of the surface which remained exposed had assumed a pink colour, implying that the layer of dead bone, whatever its thickness might have originally been, had become so thin as to be transparent, through absorption by new tissue growing in the interior. Further, on attempting to pass the eyed end of a probe between the tibia and the granulations which had enveloped it, I found to my surprise that the instrument could only be introduced for a very short distance, the granulations, with the exception of a narrow free border, being everywhere adherent. The new tissue outside the bone had coalesced with that within, after complete absorption of the intervening dead stratum. Hence the remarkable absence of discharge from around the bone." [1]

The publication of this paper had extended over a period of about six months. Within a few days of the appearance of the last part Lister was strongly urged by Syme to attend the meeting of the British Medical Association in Dublin in August. Almost at a moment's notice he decided to do so, and had much difficulty in getting ready in time a paper "On the Antiseptic Principle in the Practice of Surgery," [2] which he says "was on the whole well received and I think opportune." It did not, however, escape criticism.

Though appearing so quickly after the publication of his first paper, this address records a number of distinct advances which had been made while the first article was passing through the press. Its title deserves attention. It emphasizes the principle, not the method, and it indicates the dependence of the treatment, not upon the virtues of a particular drug, but upon the application of this principle to surgical practice.

The primitive dressing, the crust of blood and carbolic acid had been completely superseded by the putty in the treatment of compound fractures, as it was found to be more trustworthy. It was no doubt a cumbrous dressing, but its application was simplified by spreading the putty between two layers of calico. A piece of calico soaked in carbolized

[1] *Loc. cit.* p. 15.

[2] *Lancet*, 1867, vol. ii. p. 353. *British Medical Journal*, 1867, vol. ii. p. 246. *Collected Papers*, vol. ii. p. 37.

oil was still placed next the wound and left *in situ* until it might reasonably be supposed that the wound had become superficial.

In this second paper Lister first stated in print his well-known views as to the three causes of suppuration. These he classified as follows:

1st. Simple inflammatory suppuration such as that in which ordinary abscesses originate, where pus appears to be formed in consequence of an excited action of the nerves, independently of any other stimulus.

2nd. Suppuration caused by a chemical (or a mechanical) stimulus.

3rd. Suppuration caused by decomposition.

With the advance of knowledge his views as to simple inflammatory suppuration had to be modified.

The distinction between suppuration due to the action of chemical substances and that due to decomposition was at the time of very great importance. Any chemical antiseptic substance in dressings or lotions, if left in actual contact with a raw surface, was sure to make it suppurate. Carbolic acid certainly had this effect; and there was good ground to fear that surgeons, discouraged by the appearance of a drop of pus, might think the treatment had failed, and, in spite of the well-being of the patient, might discard the antiseptic dressing and thus allow decomposition to take place in the wound.

He described a simple but convincing experiment to illustrate this. A superficial sore, if covered with a closely-fitting piece of block tin, scarcely forms any pus at all, much less than if dressed with the carbolized putty, because the tin is unirritating and fits so closely that the thin layer of discharge has no time to decompose before it escapes from beneath it. On the other hand, the putty with its store of carbolic acid kept up a constant irritation and produced more suppuration. But it was a harmless, chemical, aseptic suppuration.

"There is, however," he said, "this enormous difference between the effects of carbolic acid and those of decomposition—viz. that carbolic acid stimulates only the surface to which it is first applied,

and every drop of discharge that forms weakens the stimulant by diluting it. But decomposition is a self-propagating and self-aggravating poison; and if it occurs at the surface of a severely injured limb, it will spread into all its recesses so far as any extravasated blood or shreds of dead tissue may extend, and, lying in these recesses, it will become from hour to hour more acrid till it acquires the energy of a caustic, sufficient to destroy the vitality of any tissues naturally weak from inferior vascular supply, or weakened by the injury they sustained in the accident." [1]

Nothing new was said in the paper about the treatment of abscesses. But he referred in a tentative way to that of incised wounds.

"If the severest forms of contused and lacerated wounds heal thus kindly under the antiseptic treatment, it is obvious that its application to simple incised wounds must be merely a matter of detail. I have devoted a good deal of attention to this class, but I have not yet pleased myself altogether with any of the methods I have employed. I am, however, prepared to go so far as to say that a solution of carbolic acid in twenty parts of water, while a mild and cleanly application, may be relied on for destroying any septic germs that may fall upon the wound during the performance of an operation; and also that for preventing the subsequent introduction of others, the paste above described, applied as for compound fractures, gives excellent results."

We happen to know that the first attempt at applying the principle to surgical wounds was in April, 1867: that is, four months before the Dublin meeting. Writing to his father on April 22nd, he says:

"Meanwhile I have work sufficiently engrossing. I think I mentioned in my last a very very bad case of compound fracture which seemed to throw further light upon the treatment. Well she (the very worst case I think that I have ever had) continues to do extremely well. To-day she gave me her first smile, and, being Irish, told me yesterday she had had 'an elegant night': and she made this morning her best breakfast since coming in.

But this case not only throws light on the treatment of compound fracture, but on that of wounds of *all* sorts; and I have tried the new plan (or rather an improvement on the old) in the case of a gentleman from whose arm I removed two days ago a tumour, deeply seated, and such as probably would have suppurated in a somewhat serious manner with ordinary dressing. Besides the

[1] *Collected Papers*, vol. ii. p. 40.

patient is accustomed to a bottle of port every day after dinner; not a very pleasant patient to have to do with. Well his arm is to-day as free from pain, redness or swelling as if it had not been touched, and he remarked to-day as I was finishing the dressing, 'I always understood that the dressing of wounds was a painful thing.' He, however, had not felt the slightest inconvenience from it. He is also to-day regaining the appetite which chloroform had abolished. In short the case promises to be in all respects a great success." The following week he added: "The ligatures have come away without a drop of matter forming, and he has not had the slightest redness or swelling of the limb. In short nothing could have been more satisfactory."

It is thus clear that Lister was, in April, 1867, still using the old-fashioned long ligatures hanging out of the wound. But in the Dublin paper he said:

"Further, I have found that when the antiseptic treatment is efficiently conducted, ligatures may be safely cut short and left to be disposed of by absorption or otherwise. Should this particular branch of the subject yield all that it promises, should it turn out on further trial that when the knot is applied on the antiseptic principle, we may calculate as securely as if it were absent on the occurrence of healing without any deep-seated suppuration; the deligation of main arteries in their continuity will be deprived of the two dangers that now attend it—namely, those of secondary haemorrhage and an unhealthy state of the wound."

Deligation of an artery in the continuity means cutting down upon the vessel and tying it without dividing it across. It is done for the cure of an aneurism or to stop bleeding from a distant branch. The arrest of haemorrhage in aseptic wounds is a subject to which Lister devoted years of patient study and enormous labour, as will be shown in a later chapter.

The paper ends with a statement of peculiar interest:

"There is, however, one point more that I cannot but advert to—namely, the influence of this mode of treatment upon the general healthiness of a hospital. Previous to its introduction, the two large wards in which most of my cases of accident and of operation are treated were amongst the unhealthiest in the whole surgical division of the Glasgow Royal Infirmary, in consequence, apparently, of those wards being unfavourably placed with reference to the supply of fresh air; and I have often felt ashamed, when recording the results of my practice, to have so often to allude to hospital gangrene or

pyaemia. It was interesting, though melancholy, to observe that, whenever all, or nearly all, the beds contained cases with open sores, these grievous complications were pretty sure to show themselves; so that I came to welcome simple fractures, though in themselves of little interest either for myself or the students, because their presence diminished the proportion of open sores among the patients. But since the antiseptic treatment has been brought into full operation, and wounds and abscesses no longer poison the atmosphere with putrid exhalations, my wards, though in other respects under precisely the same circumstances as before, have completely changed their character; so that during the last nine months not a single instance of pyaemia, hospital gangrene, or erysipelas has occurred in them.

As there appears to be no doubt regarding the cause of this change, the importance of the fact can hardly be exaggerated."

In these altered circumstances, Lister was able to write to his father on October 20th, " I now perform an operation for the removal of a tumour, etc., with a totally different feeling from what I used to have ; in fact, surgery is becoming a different thing altogether."

CHAPTER XIV

FIRST RECEPTION OF THE ANTISEPTIC DOCTRINE. SIR JAMES SIMPSON AND LEMAIRE. MISCONCEPTIONS

(1867-1868)

THE claim to have discovered a new principle necessitating fundamental changes in surgical practice was something altogether different from mere claims to have invented some new method of surgical treatment. The medical profession was startled, and many comments, some favourable, some adverse, soon began to appear in the medical journals.

The *Lancet* had a very appreciative article, in which the importance of the discovery was fully recognized, but, unfortunately, it appeared to confuse the discovery of the antiseptic principle with the discovery of carbolic acid. "If Professor Lister's conclusions," it said, "with regard to the power of carbolic acid in compound fractures should be confirmed by further experiment and observation, it will be difficult to over-rate the importance of what we may really call his discovery."

This confusion of ideas perplexed, though, in a way, it satisfied those who were incapable of perceiving that any discovery had been made at all, and became a ready weapon in the hands of those who were anxious to minimize its importance.

It is hardly possible to suppose that so very clever a man as Sir James Y. Simpson belonged to the former class. He had made some disparaging remarks at the Dublin meeting,

which had drawn from Lister the somewhat unguarded rejoinder at the end of a letter to the *Lancet*.

"The truth is, that the treatment which I advocate has arrived at the second stage of its progress in professional confidence. So lately as at the Association meeting in Dublin a feeble attempt was made to decry it as useless; and now it is represented as not original. Trusting that such unworthy cavils will not impede the adoption of a useful procedure,

I am, Sir, yours, &c." [1]

This rankled in Simpson's mind. Moreover, he seems to have looked upon the antiseptic treatment as a rival to an invention of his own, known as "acupressure," simply because they both aimed at procuring healing without suppuration. Acupressure was a method of arresting haemorrhage by passing needles beneath the vessels. It dispensed with the use of ligatures; and thus did away with a fruitful cause of decomposition. So far it was undoubtedly good, but certain inconveniences and even risks were involved which prevented its being widely adopted. Simpson was especially mortified that, although brilliant results were reported from Aberdeen, his method was not much used in Edinburgh or in Glasgow. This is shown by a temperate letter to Lister, written on June 16th, 1865.

"MY DEAR SIR,

I have taken the liberty of sending to you a book on Acupressure, and I hope you will do me the favour of kindly accepting of it.

Of its size I am quite ashamed; but it spun out to an extent I had no dream of when I began.

I am sanguine enough to have no fears whatever of the ultimate adoption of acupressure or some similar haemostatic. But a long stretch of time is required for all such changes. Yet in 50 months it has progressed more, I believe, than the ligature did in its first 50 years.

To my '*medical*' mind it appears most strange and inexplicable that surgeons do go on sedulously and systematically implanting by the ligature two, four, six or more fragments of dead and decomposing arterial tissue [2] in every large wound, and yet say they wish

[1] *Lancet*, 1867, vol. ii. p. 444.

[2] The small piece of artery beyond the ligature necessarily loses its vitality, and, if the wound is septic, comes away in the discharges. Under antiseptic treatment this dead portion is absorbed and replaced by living tissue.

these wounds to heal by the first intention, when the very practice of thus placing dead fragments between the lips of wounds, is amongst the surest ways to prevent adhesion succeeding. It is the stranger, when all late experience has proved that the needle is, *at least*, AS effectual a haemostatic as the ligature.

But all this apparent paradox is merely perhaps from my taking a *medical* view of a surgical subject.

I saw acupressure to-day used in a case of aneurism. It at once arrested the pulsation.

Believe me, with much respect,

Very truly yours,

J. Y. SIMPSON."

The two years that had elapsed since this was written had not softened Simpson's method of controversy. Possibly he was smarting because, a short time before, he had been obliged to refute a statement that a part of his work on acupressure had been anticipated by an Italian surgeon, Giovanni de Vigo, in the sixteenth century. However that may be, he attacked the antiseptic system and its inventor from this time forward with prolonged and consistent animosity.

In September, 1867, there appeared an anonymous letter in the *Edinburgh Daily Review* signed "Chirurgicus," stating that Lister had been antedated by Lemaire and others.

"CARBOLIC ACID IN SURGERY.

SIR,

In your issue of yesterday you have reprinted from the *North British Agriculturist* a long and interesting article on the use of carbolic acid in surgical practice. But the article is, I fear, calculated to bring down upon us some discredit—particularly among our French and German neighbours—in as far as it attributes the first surgical employment of carbolic acid to Professor Lister, of the University of Glasgow, who has only used it a few months, whilst it has been employed for years past by some Continental surgeons, in the same cases and complications as those for which Mr. Lister has availed himself of its services. Various essays have, during the last six or seven years, appeared abroad on carbolic acid and its healing and disinfectant powers. I have, for example, lying before me, a thick volume on the subject (it extends to upwards of 700 pages), written by Dr. Lemaire, of Paris, and the second edition of which was published in 1865. In this learned and able work, Dr. Lemaire discusses at great length the application of carbolic acid to

agriculture, hygiene, veterinary practice, medicine and surgery. He points out very fully and elaborately its power of destroying microscopic living organisms, germs, or sporules—adduces the opinions on these matters of Pasteur, Helmholtz, Schultze, Schwann, etc., and shows its utility in arresting suppuration in surgery, and as a dressing to compound fractures and wounds. He dwells upon its use in many other diseases, medical and surgical.

I am, etc.,

CHIRURGICUS.

Sept. 21, 1867." [1]

This was almost certainly written by Simpson, who sent copies of it broadcast amongst the profession in Glasgow and elsewhere. One of these reached the *Lancet*, and in due course a small type paragraph was inserted which, apparently without enquiry and simply on the authority of this letter, made it appear as if all Lister had done was to reproduce in this country a continental practice.[2]

Lister had never heard of Lemaire. He wrote to the *Lancet* expressing surprise that such a statement should have been made on the strength of an anonymous newspaper letter. He tried unsuccessfully to get Lemaire's book in Glasgow. No writings of his were to be found either in the library of the University or in that of the Faculty of Physicians and Surgeons. He immediately went to Edinburgh, where he found what he was in search of, in the library of the University, which in the circumstances need cause no surprise.

After studying this work he wrote a second letter to the *Lancet*.

" SIR,

Since I addressed you, a week ago, I have seen Dr. Lemaire's work on Carbolic Acid, and find that, where he speaks of surgical applications of that substance, the principles and practice which he mentions are such as sufficiently to explain the insignificance of the results.

I may repeat that I never claimed to have been the first to use carbolic acid in surgery. The success which has attended its employment here depends not so much on any specific virtue in it, as on the wonderful powers of recovery possessed by injured parts when

[1] *The Daily Review*, Edinburgh, Sept. 23rd, 1867.

[2] *Lancet*, 1867, vol. ii. p. 546.

efficiently protected against the pernicious influence of decomposition. I selected carbolic acid as the most powerful of known antiseptics; but I think it not unlikely that my object might have been gained by using, on the same principle, some familiar 'disinfectant.' And I may take this opportunity of warning some of your readers that they must not expect carbolic acid to act like a charm; but that, whether they employ this agent or some other of analogous properties, it is only by the light of sound pathology, and strict attention to practical details, that they can hope to attain in their full measure the magnificent results which the antiseptic treatment is capable of affording.

I am, Sir, yours, etc.,

JOSEPH LISTER.

WOODSIDE PLACE, GLASGOW, *Oct.* 5, 1867."

P.S.—October 6th. I have to-day received a letter, of which the following is a copy, from a gentleman personally unknown to me. He seems to have had no difficulty in distinguishing between the mere use of carbolic acid and the practice which I have recommended.

J. L."

" ABBEY STREET, CARLISLE, *Oct.* 5, 1867.

SIR,

I have the honour of being a graduate of Edinburgh. Having obtained my degree in 1866, I visited the Paris hospitals during the whole of last winter session, spending my time entirely in hospital practice and operative surgery.

I witnessed many of the capital operations, besides three cases of ovariotomy (which proved fatal).

I think it my duty to say that, during my stay of six months, I never saw anything approaching to your treatment of wounds, etc., with carbolic acid.

The majority of surgeons used for dressing wounds, etc., 'acide phénique,' 'aromatic lotion,' and tincture of arnica. The acide phénique was a very weak solution of carbolic acid, such as has been used in our hospitals for a long time to wash wounds, etc. The aromatic lotion resembles our 'red lotion,' and the tincture of arnica is like our Pharmacopoeia preparation (in full strength). I never remember seeing any other lotion used, but have often seen various kinds of our common ointments applied at some of the hospitals. The dressing of wounds, etc., was very slovenly, and the indiscriminate use of the means was still worse. A handful of charpie was taken from the basket, and dipped in acide phénique one day, and applied to the wound, etc., and next morning the process was repeated with aromatic lotion, or arnica, and so on. I need not say the results appeared to me most unsatisfactory.

I have taken the liberty of communicating these facts, and trust you will excuse me doing so; because, since my return from Paris (four months) I have seen your treatment applied in the clinical wards, Edinburgh, with the best results. I shall be happy to furnish you, if necessary, with the names and addresses of eight fellow-graduates who can bear testimony to the facts I have stated.

I am, Sir, yours obediently,

PHILIP HAIR, M.B."

Two weeks later there appeared in the *Lancet* a bitter attack by Simpson under the title "Carbolic acid and its compounds in surgery."[1] In this he accused Lister of almost culpable ignorance of medical literature. "But," he said, "let me here take the liberty of briefly pointing out that Mr. Lister has been most undoubtedly preceded by other authors in all his leading theories and uses in connexion with this subject."

There was much literal truth in what he stated about the use Lemaire had made of carbolic acid in the treatment of compound fractures, wounds and abscesses. But the manner in which he insisted upon Lemaire's priority in the use of this agent—to which Lister had never laid claim—and the way in which he ignored the principle on which Lister's treatment was founded, were either disingenuous or the result of a complete lack of appreciation.

The cloven hoof appeared at the conclusion, in which he compared the results of the antiseptic treatment with those obtained by acupressure, and asked why Lister and other surgeons persisted in rejecting a practice which had given such excellent results.

Lister very wisely did not allow himself to be drawn into a polemical discussion, but answered very shortly as follows:

"The elaborate communication of Sir James Simpson in to-day's *Lancet* may seem to require some reply. But as I have already endeavoured to place the matter in its true light without doing injustice to anyone, I must forbear from any comment on his allegations. In the forthcoming numbers of your journal, I have arranged to publish, with your permission, a series of papers fully explanatory

[1] *Lancet*, 1867, vol. ii. p. 546.

of the subject in question, and your readers will then be able to judge for themselves how far the present attack admits of justification." [1]

And so the controversy ended for a time. But it was unfortunate. Simpson had many followers who looked upon him as almost inspired, and was known by all to be a man of parts, and a keen, though not over-scrupulous, controversialist. This was a rapier thrust below the belt, and it had its effect. Attention was riveted on carbolic acid and not upon the antiseptic principle. The phrase "carbolic acid treatment," sometimes shortened to "carbolic treatment," was on every-one's lips, to Lister's mortification and disgust. Such hideous phrases as "the putty method" only showed the ignorance of those who employed them.

Lister's chagrin may be gathered from this letter to his father (Oct. 13th, 1867):

"... I think I have now said all that I am called upon to say, and if I feel sure of that, I shall be willing to let people think and talk as they please, and devote myself with fresh ardour to the work that remains to be done in the way of perfecting the methods of carrying out the treatment. It is long since I gave up any idea of having any work I might do measured according to its deserts, whatever they might be: and I have always felt that for the editors of these medical journals to take no notice at all of any articles I might write was the best that could happen; so that the good, if there was any, in my work might quietly produce its effect in improving the knowledge and treatment of disease. 'Fame is no plant that grows on mortal soil' is a passage thee quoted to me in a letter many years ago....

... I quite agree with what thee say about perfect candour in a discussion of this kind. But the truth is I never thought of such a thing as any merit attaching to happening to be the first to *apply* carbolic acid, whether to a sore, a wound, a fracture, or an abscess. Various antiseptic lotions have long been in use in surgical practice, and as soon as the antiseptic powers of carbolic acid became known, it could not be but that many surgeons would try it, as they had tried other antiseptics. Supposing that I had made the experiment with one of the antiseptics in ordinary use, say chloride of zinc, I really think it likely I should have got very much the same results, had I gone upon the same principles. But the treatment would have been just as much a new treatment. And supposing I had afterwards learnt that some other surgeon had previously dabbed

[1] *Lancet*, 1867, vol. ii. p. 595.

a preparation of chloride of zinc upon one or two compound fractures, but upon an entirely erroneous principle and so as to lead to no practical result, this would not at all have interfered with my originality in the plan of treatment.

In giving an account of the matter in my first paper in the *Lancet*, I told the story just as it happened: and it so *happened* that I had not heard of carbolic acid being used in surgery previously. I had only seen it mentioned as a deodoriser of sewage. But I certainly never thought of this as a matter of the slightest moment and never intended to be so rash as to claim that I was the first surgeon who had in any way tried it. It was the principle and method of its application that were new. The case of *abscess* illustrates the thing very well. The novelty of my treatment of abscess is not in the least affected by the fact that some French (and even English) surgeons had used carbolic acid dissolved in water as a lotion to inject into abscesses with a foetid discharge, to diminish the odour, etc. Accordingly till the *Lancet* in that leading article stated the matter so strongly (though after all not untruthfully, for they seemed to refer *then* more to the principles of using the acid than to the mere use of it) no one took any offence. Persons who have visited the Infirmary here, well aware that carbolic acid had been used before in surgery, have been quite satisfied of the novelty of the practice which I showed them. In the vacation I received a letter from a Birmingham surgeon telling me that he had long used carbolic acid in his practice, but never, as he said, on such scientific principles, and asking for some information as to particulars, and saying I should be pleased if I saw how often he ordered injured parts to be dressed 'à la Lister.' So again the writer of the article thee allude to (p. 410 of the *Lancet*) found no fault with *me*, but only with the editor. He did not say I had claimed to be the first to use carbolic acid, but that the editor gave me the credit of being the first. Even the writer of the anonymous letter in the *Daily Review* did not say *I* had made any such claim. The fact is that there is anything but merit connected with merely *applying* a new substance to all and sundry medical and surgical maladies, as Lemaire has done. And on looking carefully over his book I find reason to believe that he looks with most rose-coloured spectacles at the results of his experiments: cures cancers for instance with a few touches with an *extremely* weak watery solution of the acid. I find also that the French Academy do not think nearly so highly of his communications as he himself does, and that a Committee of the Academy after careful experiments give a very unfavourable report of the effects of the very preparations (coal tar emulsion) which he extols so very highly (carbolic acid being, as he knows, its most important ingredient).... Then again no practical result has come

of his doings. I have now the testimony of four persons who have been lately in Paris, who say that there is nothing like my treatment to be seen there. Altogether I hope thee will be satisfied with next week's letter, and I hope too that good will come from the discussion by directing attention to the principle of the treatment."

Too much attention must not be paid to leaderettes, written perhaps by inexperienced young men at so much a line, but it is not the same with authorized interviews; and making all reasonable allowances, it was not to the credit of London surgeons that, whilst Lister continued to amplify his argument in clear and scientific language, and whilst he and his pupils frequently published their results, the London journals should have contained such rubbish as appeared in their columns during 1867-1868.

Here are a few examples taken from the reports of such interviews:

"We cannot concede to him the credit of having introduced to the Medical public carbolic acid as a local application." [1]

"Mr. R. has occasionally sponged the wound, in the operating theatre, before applying the sutures, but not having found any advantage arise from it, he has discontinued the practice." [2]

"Mr. C. does not approve of Lister's method, which he considers meddlesome. Mr. C.'s experience is that wounds unite readily when left alone." [3]

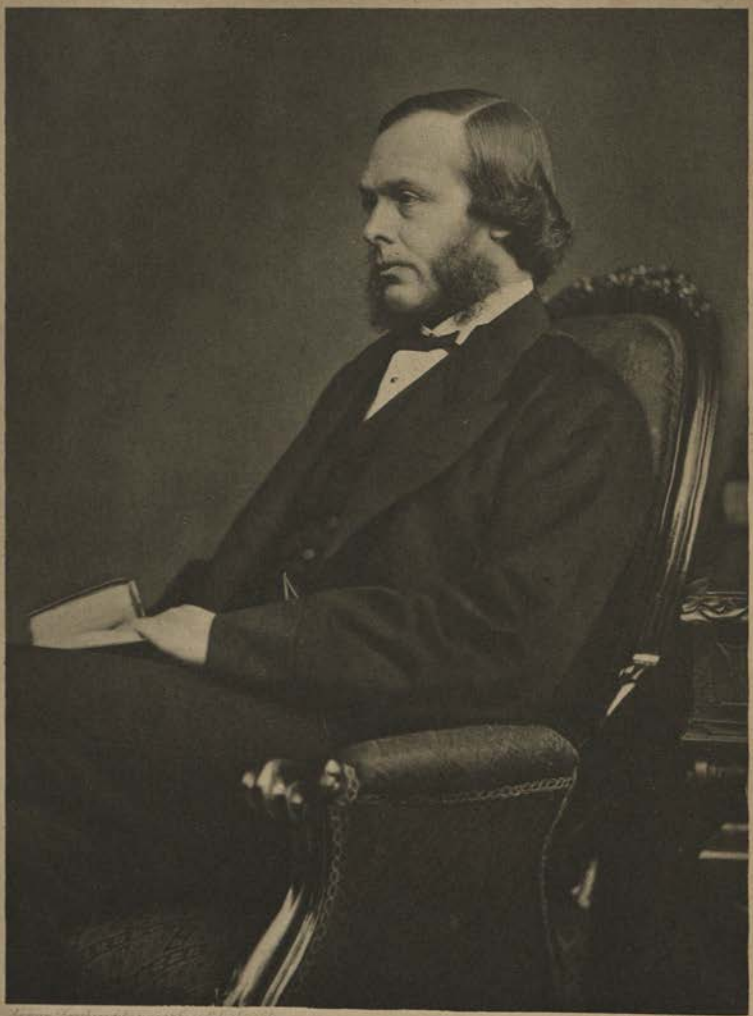
"A considerable proportion of cases have been attended with very satisfactory results; some have conformed in every respect with the theory of action promulgated by Professor Lister; but in a good number of instances, while the antiseptic action has uniformly been effective in utterly destroying putrefaction and fetor, yet in regard to its antipurulent properties such satisfactory results have not been obtained from the putty method." [4]

To give the medical papers their due, however, there was much insight in a question asked by the *Lancet* in a commentary on the results obtained in the Dowlais Iron Works. "Mr. Cresswell, whose surgical experience is very great, says that

[1] *Medical Times and Gazette*, 1867, vol. ii. p. 355.
[2] *Lancet*, 1868, vol. ii. p. 634.
[3] *Lancet*, 1868, vol. ii. p. 728.
[4] *Lancet*, 1868, vol. ii. p. 762.

the use of carbolic acid in the treatment of wounds has revolutionised surgical practice at Dowlais. And yet Mr. Lister's treatment does not find much favour in London. Are the conditions of suppuration different here from those in Glasgow or Dowlais? Or is it that the antiseptic treatment is not tried with that care without which Mr. Lister has always pointed out it does not succeed? " [1]

[1] *Lancet*, 1868, vol. ii. p. 324.



Annan Brothers photographers Edinburgh. Emery Walker ph.sc.

Joseph Lister

aged about 40

CHAPTER XV

CANDIDATURE FOR A PROFESSORSHIP AT UNIVERSITY COLLEGE, LONDON. VISITORS FROM ABROAD. ELABORATION OF THE ANTISEPTIC TREATMENT (1866-1869)

DURING the summer of 1866, amidst all these engrossing occupations, Lister was tempted, by the occurrence of a vacancy on the staff of University College, London, to make an attempt to return to his *alma mater*. The conditions were peculiar. On the one hand, University College was not a close borough. The ranks of its professors had often been recruited from outside. Indeed its motto "Cuncti adsint, meritæque expectent præmia palmæ" applied as much to the staff as to the students. It was, therefore, anticipated that distinguished men, especially old University College men who had made reputations elsewhere, would apply for appointments which were supposed to be open to all the world without prejudice or favour. On the other hand, John Marshall, the candidate already in the field, had great claims on the chair. He was a scientific though not a brilliant surgeon, and a good teacher; better known for his work in anatomy and physiology than for strictly professional accomplishments. He had served an exceptionally long apprenticeship as assistant surgeon to the hospital, and it would have been a bitter disappointment to him to be passed over when the full surgeoncy, for which he had been patiently waiting for eighteen years, fell vacant.

It was understood that the surgeoncy to the hospital would go with the professorship at the College. The Senate and the Council were thus in a difficult position, and the

result appeared to be doubtful up to the last moment. Eventually Marshall was elected. He occupied the chair of Systematic Surgery for many years, during which time he filled a distinguished place in the surgical world in London.

Lister had looked forward to the election with hope, indeed almost with confidence. He wished to obtain the professorship, not so much on its own account, and because it would have brought him back to London and the circle of his own family and friends, as because it would have given him the opportunity of preaching his gospel in the metropolis. Accordingly, although he fancied that he was unconcerned, the actual news of the defeat "affected" him a good deal. Writing to his father on August 6th, 1866, he says: "The disappointment was at first extremely severe: more so than I had expected." He goes on to describe how, after a bad night and some philosophical meditations, he was able to go to the Infirmary next day in so happy a frame of mind that his house-surgeon, who expected to hear the news of his appointment, inferred from his face that he had been successful, and he concludes, "At last this is a noble field of labour. And I am sure the canvass is in no way to be regretted on my account. Any effect it has had can only have been to bring me more into notice. And if another opening should occur in London, I have at least declared my willingness to go there, and perhaps paved the way for going."

This letter crossed in the post one from his father:

"UPTON. 8. mo 5. 1866.

MY OWN DEAR SON,

. . . . . .

I can hardly forbear, as I sit alone while the others are at evening meeting, to express to thee my condolence. It must be very disappointing to thee as to all of us... but most of all to myself, who had fondly hoped for thee to be nearer me during the short time that might remain to me in this changing world.... We must now continue to think of thee as in thy present important post which indeed has much to recommend it—and though not tied to it by the *need* of its emoluments, thou wouldst hardly have been willing to leave it but for the prospect of extensive usefulness that seemed to open in thy natural place, and let us trust, short-sighted beings as we are, that all may be for the best."

It is doubtful whether the cause of antiseptic surgery would have benefited by Lister's coming to London at this time. University College was no doubt a remarkably flourishing school, and more closely united than any other to the University; but the number of students and the clinical opportunities were far less than those in Glasgow; and, though it could not be foreseen, there were troublous days ahead when the hospital was being rebuilt and the school was consequently reduced to a minimum for a time.

Moreover, London is more like a country than a town: full of discordant interests. A self-contained city, with one large hospital and one medical school, is a better centre for the promulgation of a new doctrine. One notable clinic, even in a remote place, attracts and commands the concentrated attention of intelligent visitors, as Lister's experience in Glasgow and afterwards at Edinburgh clearly showed.

Mr. Syme, whose short experience of University College possibly prejudiced him and made him take too sinister a view of professional life in London, wrote an encouraging letter on August 12th.

"I am glad you take this conduct on the part of U.C. in the right way—not as a discouragement but as an inducement to exertion. In the end you may not improbably have reason to feel grateful for not being allowed to quit your present position. It is a great field, much greater for hospital practice than you could possibly have had in London—and also much more favourable for the acquisition—or as I should rather say the extension of professional character. London has its advantages no doubt, but, when these are compared with its disadvantages, your present position I sincerely believe is more fruitful of rational happiness. In order to maintain a good metropolitan place it is necessary to do a great deal of dirty work—which I am quite sure you would decline—and therefore have the discomfort of all sorts of worthless persons puffed up as your equals, or superiors, while at present you are perfectly secure from such consequences. It was such considerations that led me to return from London, and they should, I think reconcile you to not going there."

So he settled down again to his Glasgow work as if nothing had happened, busy with his University and hospital occupations, and with his whole soul absorbed in the perfecting of his system of treatment.

The antiseptic principle, and the system of treatment founded upon it, had now been clearly and publicly explained. From all parts of the world comments and reports of cases successful or otherwise appeared in the medical journals, and foreign professors, notably Thiersch of Leipzig, sent emissaries to see what was going on.

On April 5th, 1868, Lister wrote to his father:

"I mean to send along with this an *Australian Medical Journal* sent me by the author of a paper in it giving some cases in which he has acted on the antiseptic system with great satisfaction. We have lately had two visitors from a distance, both of whom came to Glasgow to see the antiseptic practice: one from Petersburg, well conversant with the *continental* mode of using carbolic acid and thoroughly appreciating our system here, as calculated "to revolutionize Surgery": the other from the Southern States of N. America, a very gentlemanly man, who declared himself a complete convert to the system. So it is gradually spreading."

And he tells of another young American from the Northern States who was enthusiastic, and said 'I'll fight this in New York, Doctor.'"

British surgeons also, especially assistant surgeons from great hospitals, began to come to Glasgow, settling down for several days and devoting their whole time to studying Lister's practice in a way that would have been impossible in London. Joseph Bell and others from Edinburgh, MacCormac, Croft, Berkeley Hill and Marcus Beck from London, all of whom became distinguished men, came to see, and went away convinced that they had seen something new. Possibly some were at first rather shocked by what they saw, as appears to have been the case with Beck. On July 5th, 1868, Lister wrote to his father:

"Three days ago I had a nice case for the antiseptic treatment, a 'loose cartilage' in the knee joint, 1¼ inch long by 1 inch broad and ¼ inch thick: the largest I ever saw; and causing the patient much inconvenience. I removed it by a free incision into the *knee joint*!! a thing I should not have thought of doing without the antiseptic system. I had carbolic oil dropped on the wound as I cut, and drew out the cartilage under cover of an antiseptic rag: and dressed with the plaster. The patient has not had the slightest pain or symptom of any kind. To-day the discharge is about one

drop for 24 hours. So we may say it has been a complete success. Marcus was rather horrified at the operation: but finds that the result justifies it."

To the ordinary surgeon of the day, working on orthodox lines, such a procedure would have appeared criminal.

About this time, Lister's faith in his new system was put to a severe test. One of his sisters was found to be suffering from a mortal complaint which could only be relieved by a dangerous operation not hitherto performed by anyone, and which no surgeon of the day would have felt justified in undertaking either with or without antiseptic precautions. Obviously, unless the patient were to be left to her fate, he would have to perform the operation himself. After much thought, and a long talk with Mr. Syme, he braced himself to the effort, and on June 16th, 1867, wrote to his father:

"I suppose before this reaches thee the operation on darling B. will be over. It was evidently undesirable to delay a day longer than was necessary as soon as it was determined that it was to be: so last evening I finally made arrangements for the nurse for her, and we intend that the operation shall be at half past one o'clock to-morrow. My visit to Mr. Syme was a most satisfactory one. He said 'no one can say that the operation' (I propose to perform) 'does not afford a chance,' and he also alluded to the carbolic acid treatment of wounds (which he has been trying with much satisfaction) as depriving the operation of danger. I felt his true kindness and *manifest*, though little expressed, sympathy, very much, and left Edinburgh much relieved. Not that I do not feel the prospect of operating on my sweet sister in this way *very* much: but that the degree of really legitimate hope that has opened up to us has greater influence. It is very satisfactory to me that B. seems to have thorough confidence in me. She distinctly says she would much rather have me to perform the operation than anyone else. And considering *what* the operation is to be I would rather not let anyone else do it."

The following day he described this "*most* formidable undertaking" as very satisfactorily over, and added, "I am very glad it has been done. . . . I may say the operation was done at *least* as well as if she had not been my sister. But I do not wish to do such a thing again." A friend who

was present says that it appeared to be a fearful ordeal for him, though the operation was perfectly well performed.

Surgeons who came to Glasgow and actually saw what was taking place seem to have been well satisfied. Seeing is more convincing than hearing, as Lister, who had many a verse of Horace at his command, often reminded his students, recalling the testimony of the poet as to the value of the "faithful eyes."

> "Segnius irritant animos demissa per aurem,
> Quam quæ sunt oculis subjecta fidelibus."

And, as time went on, his students exercised a more important influence in spreading the doctrine than casual visitors. Convinced by the evidence of both eyes and ears, they formed a band of enthusiastic disciples. Year by year they went out into all parts of the empire, teaching and practising with the authority of those who knew that they were not following cunningly devised fables. Amongst them one name must be specially mentioned. Hector Cameron[1] was house surgeon in 1866, and in 1867 became more intimately connected with Lister, assisting him in his private practice and with his experiments. The acquaintance ripened into a close and lifelong friendship. In due course Cameron became surgeon to the Glasgow Royal Infirmary and Professor of Clinical Surgery at the University. He has done as much as any man to prove by practice and precept the value of the antiseptic treatment, and the world is indebted to him for many clear expositions of its history and development.

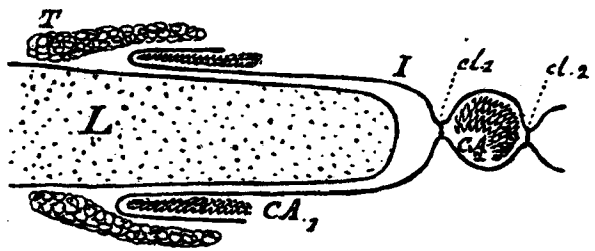
Students and casual visitors to Glasgow in 1869 saw something very different from that which has so far been described. The early methods were not perfectly satisfactory, and they were therefore frequently modified. One of the most important modifications was in the first purification of a recent wound. Lister no longer employed undiluted carbolic acid for this purpose, because it caused a certain amount of superficial sloughing, and he found that a five per cent. watery solution was usually strong enough. For a short time

[1] Afterwards Sir Hector Cameron.

he had used an oily solution, 1 in 4, but this was inconvenient and untrustworthy.

He recognized from the first that antiseptics, in so far as they damaged the tissues, were evils, though as he thought necessary evils, and even at this time he was trying how far it would be possible to dispense with them. One of these attempts, which gave good results, but which was too complicated to recommend for general adoption, was a new way of dressing amputations by excluding the germs mechanically. The description of it in a letter to his father (Nov. 30th, 1868), shows the direction of his thoughts on this very important question.

"I am at work on what promises to be a certain way of managing stumps after amputation: viz., covering the stump with an India



rubber tube, very thin, but strong: so that it will exclude germs *mechanically*, by the absence of pores in it, except at the ends, which are guarded by the antiseptic, as seen in section in this diagram.

L. Section of limb (stump).

I. India rubber tube.

T. Towel to absorb the discharge escaping beneath the folded edge of the India rubber tube.

CA_1. Cloth containing carbolic acid in oil, enclosed in the folded part of *I*, so as to be protected from contact with *T*, and so retain its acid pure, to act through the India rubber upon the discharges that escape from the stump.

CA_2. Lint with carbolic acid in oil enclosed in a part of the tube shut off from the rest by 2 clamps, cl_1, cl_2, this antiseptic lint guarding the free end of the tube, which the clamps could not make quite air-tight.

Thus the germs are prevented from entering the tube alive at either end, while the stump at the end where the wound is, receives no stimulation from the carbolic acid, which does not act on that

part of the india rubber which covers the wound. This plan promises to bring the treatment of stumps to a certainty. Already one has done excellently."

From the same point of view—that of preventing the antiseptic from continually stimulating and irritating the wound—he introduced what he called a "protective." This was a material unstimulating in itself and impervious to carbolic acid. The intention was to place a piece of the protective, of limited size, in immediate contact with the wound, in order to protect it from the irritation of the dressing which overlapped the protective widely on every side.

He was using the protective in 1869; but he first described it in 1870 in an elaborate clinical lecture at Edinburgh, in which he thus explained its meaning and purpose:

"Of all those who use antiseptics in surgery, I expect that I apply them least to the surface of the wound. After the first dressing, the object which I always aim at is to have the material in contact with the exposed tissues approximate as closely as possible to the perfectly bland and neutral characters of the healthy living textures. If you consider the circumstances of a simple fracture, which you cannot too often call to mind if you wish to keep your ideas clear and right upon this subject—if you remember how the severe contused internal wound, with the interstices of the mangled tissues loaded with extravasated blood, recovers quickly and surely under the protection of the unbroken integument, it is plain that all that is required in an external wound is to guard it against the disturbing influence of external agency. The injured tissues do not need to be 'stimulated' or treated with any mysterious 'specific'; ALL THAT THEY NEED IS TO BE LET ALONE. Nature will take care of them: those which are weakened will recover, and those which have been deprived of vitality by the injury will serve as pabulum for their living neighbours. Now of all external agencies the most injurious by far is putrefaction, and this, above all, we endeavour to exclude. But a substance employed with this object, if sufficiently potent to destroy the life of the putrefactive organisms, cannot fail to be abnormally stimulating to the exposed tissues; and these must be protected from its action if the wound is to progress exactly like a subcutaneous injury.

Our 'protective,' then, should be a material unstimulating in its own substance, and impervious to carbolic acid. At the same time it must be insoluble in the discharges, and sufficiently supple

to apply itself readily to the part. . . . You will bear in mind that the protective is not designed to have any persistent antiseptic virtue; and that, like the wound at the first dressing, it must be freely overlapped at every point by the antiseptic plaster.

These principles will be found to apply whatever be the materials used for carrying out the antiseptic system. *An antiseptic to exclude putrefaction, with a protective to exclude the antiseptic, will by their joint action keep the wound from abnormal stimulus.*" [1]

Many substances were tried for this "protective." Caoutchouc, which first suggested itself, allowed the carbolic acid to pass through with the utmost freedom. Block tin was too rigid, and tinfoil soon wore into holes. Gold-leaf, for a time, seemed promising, but it was too fragile a material to work with.[2] Very thin toughened glass would have been ideal, as the wound could have been inspected without displacing it, but this could not be obtained. At last he fixed upon oiled silk covered with copal varnish. The copal varnish opposed the passage of the carbolic acid much more than the oiled silk. But when this varnished oiled silk was dipped in carbolic acid lotion in order to destroy all germs adhering to the surface before applying it to a wound, the lotion ran off like water from a duck's back. Lister thought that there was a chance that germ-bearing dust might settle on the dry surface in the momentary transit from the basin of lotion to the wound. He, therefore, coated the protective with a layer of dextrine and starch, which ensured a complete and uniform wetting when it was dipped in the lotion.

Thus prepared, the protective is obtainable at the present day, and is still used in certain circumstances by those who understand its purposes and its importance. Improved dressings and improved technique, especially the more

[1] *Collected Papers*, vol. ii. p. 143.

[2] "I have been lately trying a microscopically thin layer of metal, in the form in which you see it in this specimen. Cotton cloth, coated on one side with caoutchouc, is gilded on the caoutchouc side, and then covered with a film of india-rubber applied in solution. We have ascertained that the gold-leaf thus enclosed between two layers of caoutchouc spread on cloth wears thoroughly well; and, if I can get a manufacturer to enter into the thing, I have hopes of obtaining at last something like a perfect protective." *Collected Papers*, vol. ii. p. 144.

sparing use of antiseptic materials at operations and consequent diminution of discharge, have, however, rendered a protective less necessary than formerly. It has thus almost passed out of use, and its meaning has been forgotten, but the term survives and is applied, now to one material now to another, according to the whim of the pharmaceutical chemist.

After each of Lister's migrations, one room in the new home, though perhaps intended to be a subsidiary consulting room, was at once devoted to the purposes of a laboratory. It contained, not surgical appliances, but, according to the particular investigations upon which he might be engaged, flasks, retort-stands, spirit-lamps, or hot boxes; and always the microscope and an array of chemicals. Not a day passed without some experiment or observation, perhaps on blood obtained from the knacker's yard, perhaps on a pathological specimen, or on some micro-organism whose life history he was tracing. Between 1867 and 1869 his laboratory was like that of a pharmaceutical chemist, so keen was the search for an efficient protective and also for a perfect dressing. The putty was objectionably cumbrous; and he wanted something less bulky, which would still meet the requirements of his ideal dressing—some material that would hold the carbolic acid with such tenacity that it would not be washed away by the discharges before the dressing was removed, and would be free from irritating properties, so as not to interfere with healing. The investigation involved countless experiments. Various bodies, such as resin, had the requisite affinity for carbolic acid, but, when mixed with it, were either so sticky that they adhered to the skin and prevented the escape of the discharge, or else so brittle that they cracked. In the course of time all the carbolic acid would be washed out of that part of the plaister immediately over the wound, and if a crack occurred in this particular situation there would be nothing to prevent decomposition from working its way through the crack to the wound, in the discharges which had only come in contact with that part of the dressing that had lost its antiseptic.

The first improved dressing—the "cerate dressing"—consisted of a mixture of paraffin, wax, a little olive oil and carbolic acid, spread on calico. In pharmaceutical language it was an "elegant preparation," but it had one defect, on account of which it was, before long, discarded.

A letter to his father (8th March, 1868), gives some idea of his untiring patience over details, and of the goal which he always had in view:

"Unless I write this evening, my weekly letter can hardly be written; for I have abundant engagements for to-morrow. Indeed I have enough for three people's energies to occupy me at present. Preparation for the *Lancet* would do for one individual; practice, hospital and private, would be amply sufficient for a second; and College duties, including looking over the answers of the students to a class examination, together with correspondence, would do well for a third person. Hence I have a constant feeling that much, very much, that I desire to accomplish is perpetually left undone. That which I am *forced* to do daily is to give my lecture, and to do what I can for the patients under my care. And if thee were in my place, thee would, I suspect, feel as I do, that the latter is the most pressing of *all*. And if anything suggests itself as a means of procuring greater safety to those who come to me, entrusting their lives to me, I cannot but embrace it. In the course of last week such a thing has occurred, which I almost hesitate to mention to thee, lest thee should think I ought to have been writing instead of working at it. But I do not like to keep it from thee. It is this. The putty having proved itself quite *trustworthy*, whereas a *thick* folded cloth, soaked with an oily solution of carbolic acid is *not* trustworthy, although containing much more of the acid, but the putty having various practical inconveniences, such as its weight; I endeavoured to obtain a means of getting the advantages of the putty without its disadvantages. The efficacy of the putty evidently depends upon its impermeability to the discharge; which is shed by it instead of penetrating into its substance as it does into that of a cloth. Hence it seemed that if the oily material in which the acid is dissolved could be got in a *solid* form, there would be no need of the heavy whitening, which is only used to give consistence to the material, and yet constitutes five sixths of its weight. To procure a solid fat fit for the purpose proved no easy matter. It must be of just the right firmness, not melting at the temperature of the body, and not adhering to the surface of the skin (else it would confine the discharge). But I seem to have succeeded with the following. Paraffine (such as is used for the Paraffine candles) which does not melt with the

warmth of the body and is not adhesive, is the basis. To give it tenacity I add a little wax, and to give sufficient softness a little olive oil.

Paraffine	6 parts.
Wax	2 ,,
Olive oil	1 ,,

Carbolic acid 1 or ½ or ¼, etc. according to the purpose.

Well, this acts most beautifully. It is really astonishing how thin a layer will keep the discharge perfectly sweet. And not only a thin layer, but a comparatively small amount of surface, answers the purpose. And the dressing being peculiarly light (Paraffine has only about ⅔ the specific gravity of water) all the inconveniences of the putty are got rid of, along with superior efficiency for some situations, as the new paste can be applied to parts to which it was impossible to apply the putty satisfactorily.

Such has been the principal result of my last week's work. Thee will readily understand how much thought, in season and out of season, it has required, and how much labour, to get it into shape. But it has been, I hope, my best week's work for many a day."

On further trial, however, the cerate plaister proved to be too brittle. The next attempt produced a really admirable plaister. It was made of ordinary shell-lac mixed with carbolic acid in the proportion of 4 of the former to 1 of the latter. The shell-lac held the carbolic acid sufficiently firmly, and as long as it did so was beautifully flexible. But it was too sticky. To overcome this defect various devices were adopted; one was to coat it with a thin layer of gutta percha which did not impede the passage of the carbolic acid; another, to dust it over with a powder.

The way in which he threw himself into problems like these, and the kind of work that went on in his laboratory, may be gathered from the following, perhaps tedious, but very characteristic, letter written during a summer holiday to his then house-surgeon, Dr. Malloch, of Ontario, which is now religiously preserved by Dr. Harvey Cushing in the Brigham Hospital, Boston, U.S.A.

"VENTNOR, 10*th Septr.* 1868.

MY DEAR MALLOCH:—

I was very glad to get your letter yesterday, and much obliged to you for the reports. So McVain had to be dismissed at last! I gather, however, that the antiseptic treatment had in so far

succeeded that the wounds were superficial granulating sores when he went away. Do you remember whether the smaller wound also was in this state, or only the larger? Your report of the action of the lac plaster with the thin film of gutta percha is very satisfactory in so far as it goes, but I was very anxious to know how it behaves as regards sticking to the skin. So you will, before you get this, receive a telegram making enquiry on that point, and also as to its resisting movement and wear.

Since I have been here I have tried whether the same object (preventing adhesion of the lac) might not be got more satisfactorily by applying some kind of powder to the surface of the lac, so as to give it a bloom (as it were) that would keep it from sticking. But I find that most powders refuse to stick at all. Oxide of lead, however, forms an exception, and not only sticks, but becomes incorporated with the lac when applied to the surface at a temperature of 212° F. The lac plaster, when treated in this way, is deprived to a very great extent of its adhesiveness; so much so that I think the trifling adhesiveness that remains is unobjectionable, if not advantageous. But I have only tested it on a small scale, by trying it on my finger, and I am anxious that you should try it, and report how it works in actual practice. And I am desirous that as little time should be lost as possible, seeing that the determining of the best way of preparing the lac plaster keeps me from finishing my address for publication, and time is beginning to run away terribly quickly! Will you then be so kind as to make the trial as soon as possible, and let me know the result at once; posting your report by the early post, *i.e.* putting your letter into the receiving box before 4.30 (or 5.15, if at the general post-office).

I enclose a specimen to show what you are to produce. The mode of doing it would be as follows. First with the dry finger rub off the film of gutta percha from a portion of your lac plaster of any suitable size, say a foot square: and place the plaster (lac upwards) upon a metal plate (say a piece of tin) and sprinkle over the surface of the lac some 'red lead' (this, if not in the laboratory, can be got from any chemist or painter: it is a bright red powder, used as a pigment). The powder should be diffused pretty uniformly, which can be done readily enough with a camel's hair brush. But, provided the whole surface is *covered*, it is of no consequence whether the layer is a little lumpy or not. A thin layer is enough, but a little additional thickness does no harm. Then place the tin on the top of some vessel containing boiling water. I dare say the wash house boiler would do well; the tin being placed upon the cover of the boiler, if the cover is metallic: otherwise a plate of iron should be put on instead of the cover (supposing the cover to be of wood). Or a frying-pan, or large sauce-pan would do, the tin plate being put

directly over the vessel. This, however, you will do as common sense may dictate. The plaster is to be left at the temperature of 212° (or near it) for a few minutes, say five. The tin plate is then removed and placed where it may cool rapidly. When it is cool, the superfluous red lead is brushed off, and the process is complete. You will find the remaining lead is incorporated, so that it cannot be washed off by water. When, however, you wish to use it for compound fracture, etc., you can wash away the lead by a small cloth dipped in spirit of wine, or still better, chloroform, and you will find the plaster restored to its original adhesiveness, or even more. (If you use chloroform the adhesiveness is greater.)

If the lac has gone through the calico from the heat, it would stick to a cloth placed over it; but this difficulty can be got over by a bit of tissue paper, or a bit of thin calico outside it. If you wish to use two layers, as when there is much movement—for example, in the abscess in the groin in Ward 17—put on the layer next the skin with the lead on, and the one outside with the lead removed by chloroform. The two layers will then adhere firmly and, I hope, be amply strong enough. Then when you have prepared the plaster, put it on some 4 cases or so, so as to test it fairly, and report next day. So much time is lost by the post to this island that I hope you will not lose a day in getting the thing tried.

When you write, will you mention the girl's arm with necrosis, and also how Harley goes on, &c. Don't let Harley go home till the boot has done all it can for him.

I shall be much interested to hear how your necrosis of femur has got on.

Regretting to have to give you so much trouble,

I remain,

Yours very truly,

JOSEPH LISTER."

The " lac plaister " was used in the same way as the putty. A piece of suitable size was placed on the wound, and its edges were luted down with adhesive plaister. It answered well for wrapping round limbs and applying to flat surfaces, but was not well adapted for use on irregularly shaped parts of the body, such as the armpit. However, it was the ordinary antiseptic dressing till 1870, when Lister discarded dressings intentionally devised for the purpose of not absorbing discharges in favour of those which absorbed them freely.

The description of the lac plaister appeared in an address delivered before the Medico-Chirurgical Society of Glasgow

in April, 1868.[1] This address, though it did not profess to give a complete account of the antiseptic system, being based upon some illustrations which happened to be at his disposal at the time, is very important, because it showed what advances had already been made, and indicated the directions in which further development might be anticipated.

It was delivered extempore and in a style which more resembles that of his clinical lectures than that of the elaborate, carefully thought out and highly polished papers which we have so far had to consider. Its genesis is thus described in a letter to his father, dated 21st April, 1868.

"Agnes told yesterday of my inability to write thee, and also told of my address having passed off satisfactorily. I will now add some particulars in the few minutes which are alone at my disposal. For I have another clinical examination this afternoon, to occupy me three hours!

When I came to think how I should introduce my objects of interest to the Medico Chirurgical Society, I found it might be best to allude at the same time to other interesting, and somewhat allied matters. So the result was that I gave an address that occupied two hours all but five minutes in its delivery, including pretty nearly all that I had desired to say in my next article for the *Lancet*, and a great deal more. The stab of the chest case, and the old woman run over by the omnibus and various others were brought in. I also took my stand distinctly as to my part in the antiseptic system. The large room was filled with probably the largest company that ever assembled in it; and the most attentive silence was maintained to the last. The superintendent of the Infirmary told me he could have listened on to me for a longer time, which is a good deal to say when a man has had two hours of listening. Prof. Allen Thomson was in the chair and expressed himself in handsome terms of the whole affair. *Some*, one or two, tried to disparage; but they did not touch my facts, and made very poor appearances. Two of the chief reporters of one of the principal newspapers were there and hard at work, and in a day or two I am to get their copy of the address. Then it must be put into shape for printing and I intend to send it like the Dublin one to both the *Lancet* and the *British Medical Journal*. But it will be much longer than the Dublin one. That took I think about half an hour to deliver. This near two hours, as I said before. It will take a deal of polishing, and I mean

[1] *Brit. Med. Journ.*, 1868, vol. ii. pp. 53, 101, 461, 515; 1869, vol. i. p. 301. *Collected Papers*, vol. ii. p. 51.

to have some woodcuts, and also to have separate copies printed for private distribution. I fancy both thee and Arthur will express approval of the *amount* of publication, if not of the quality of the material."

In taking his stand as to his own part in the antiseptic system, he stated emphatically that there was no essential relationship between this system and carbolic acid, pointing out that, though carbolic acid happened to be the first antiseptic agent he had used, it was possible that others might answer the purpose equally well. In illustration he described a successful case of compound fracture treated on the same principle with chloride of zinc, but added that, for most purposes, chloride of zinc was inferior to carbolic acid.

He also insisted that, in order to carry out the antiseptic treatment successfully, an intelligent belief in the truth of the germ theory of putrefaction was essential, and to bring the matter home to his audience he produced the results of an experiment—his first in this field—a modification of one of Pasteur's, though originally devised by Chevreul. Fresh urine was introduced into four flasks. The necks, which were wide and straight when the fluid was introduced, had, after careful cleansing, been drawn out, after being heated over a spirit lamp, into tubes about a line in diameter. In three of the flasks these elongated and attenuated necks were bent at various angles; in the fourth the neck was cut short and left vertical, but its orifice was reduced to even smaller dimensions than in the others. The contents of each flask were then boiled for five minutes, the steam issuing freely from the orifice. The heat was then withdrawn and air was allowed to rush into the flask to take the place of the condensed steam. "The flasks were then left undisturbed in the same room, the ends of their necks being still open so as to permit free exit and entrance of air as a consequence of the diurnal changes of temperature which, of course, involved alternate expansions and condensations of the contained gases." Sometimes on a cold night he raised the temperature of the room, then put out the fire and threw open the windows, and thus caused a depression of temperature of twenty degrees. And yet after six months the fluid remained un-

altered except in the flask with the straight neck, in which, as it happened, the change was not a putrefactive one, but depended upon the growth of a mould. "Surely we are safe," he said, "in drawing the inference that, in the case of this putrescible substance at least, the atmospheric gases alone are incapable of inducing putrefaction. What is it, then, that is essential to putrefaction of urine by atmospheric influence which the bent tubes have arrested? It cannot be any of the gases; but it may be, it must be, some particles suspended in them, some dust, which the angles of the tubes might arrest mechanically. And this conclusion, inevitable as it is from the consideration of the flasks with bent necks, is confirmed by comparison with the other in which the orifice, though narrower, was purposely so arranged as to afford a better chance for the introduction of particles of dust, and in which accordingly chemical changes soon declared themselves in the contained liquid."

These flasks became classical. Two years later they were carried to Edinburgh, where they were shown to many generations of students. During this perilous journey Lister nursed them carefully on his knee, to the amusement of his fellow passengers. In the jolting drive from the station across the cobbled streets of Edinburgh, the contents were churned up so that "the upper part of the body of each flask was full of a frothy mixture of the putrescible fluid and the atmospheric gases." Even after this severe test, however, no decomposition occurred. He told this story to a Plymouth audience four years after the experiment was made; the fluid in the flasks was still clear, and in 1877 they survived a yet more dangerous journey south, and were shown to his class at King's College, London. It is believed that in the end they were accidentally destroyed by fire, but that the contents retained their clearness to the last.

No more simple or more convincing illustration of the truth of the germ theory could have been offered; none more staggering to the believers in "equivocal" or "spontaneous" generation, a question which, as Lister said, is essentially involved in the germ theory of putrefaction.

Many other fundamental matters to which we have already alluded were dealt with in this address, each of which was illustrated by some striking case. They should be studied in the original, but must not be recapitulated here.

One new subject, however, of the greatest importance was only lightly touched upon: the arrest of haemorrhage in aseptic wounds. It was already occupying Lister's close attention, and will be considered in some detail in the next chapter.

CHAPTER XVI

THE CATGUT LIGATURE. APPOINTMENT TO THE CHAIR OF CLINICAL SURGERY IN EDINBURGH. DEATH OF HIS FATHER

(1867-1869)

THE best method of arresting haemorrhage in aseptic wounds presented a completely new problem.

In septic wounds all ligatures had to come away. They were sources of irritation; no one really knew why. It was known that smooth metallic foreign bodies, such as shot or even bullets, might occasionally remain as honoured relics in the human body for a life-time without causing suppuration. But it was different with silk or thread ligatures; so the custom was to leave their ends hanging out of the wounds in order that they might be pulled out when they had ulcerated through the artery to which they had been applied. There they lay for a week or ten days: a more or less efficient drain, but invariably giving rise to suppuration, and a frequent cause of "secondary haemorrhage."[1]

It was now obvious to Lister that these ligatures were sources of irritation, because the blood and serum occupying their meshes formed a favourable nidus for the growth of micro-organisms; and he anticipated that, if germs were excluded, the evil would disappear. In his own words:

"A foreign body introduced amongst the tissues does not exert any disturbing influence upon them, unless it be either mechanically or chemically irritating. Thus it is well known that a needle or a

[1] Secondary haemorrhage is bleeding that occurs days or weeks after the infliction of a wound; owing to ulceration extending into a blood vessel, and the softening of the clot which had previously plugged the vessel.

spiculum of glass may lie for an indefinite period embedded in the living textures without inducing suppuration; and any irritation which may result is due simply to the rigidity and form of the foreign solid. Now, a bit of silk or linen thread being composed of materials of soft consistence and as unstimulating chemically as glass or steel, its presence amongst the tissues cannot of itself occasion any disturbance. But, unlike the glass or metal, the thread is porous, and contains in its interstices putrefactive germs, which, developing in the serum that bathes the ligature, give rise to the acrid products of decomposition, and these, in their turn, stimulate the surrounding tissues to granulation and suppuration. If, however, the thread were steeped in some liquid calculated to destroy the life of the germs in its interstices, and the wound by which it was introduced were dressed antiseptically, the ends of the ligature being cut short, it might be left with confidence that its presence would not interfere with primary union, or occasion any disorder in the surrounding parts." [1]

He first put the matter to a practical test on December 12th, 1867, by tying the carotid artery of a horse with a piece of unwaxed purse-silk which had been steeped for some time in a saturated watery solution of carbolic acid. The wound was dressed antiseptically, by which term Lister "did not mean dressed with an antiseptic, but dressed so as to ensure absence of putrefaction." Healing took place, without redness or swelling, by "primary union"; and as the old horse, whose health was quite unaffected by the operation, died nearly six weeks afterwards of exhaustion "from struggling ineffectually to rise from the recumbent posture," Lister had the opportunity of dissecting the part, and found the silk unchanged but bridged over externally by dense fibrous tissue.

Encouraged by this success, he chose the first opportunity that offered of tying an artery in its continuity [2] on the human subject in the same way. The case was one of great interest and rarity: a femoral aneurism in a lady 51 years of age. It was the first time he had tied the external iliac artery, and this added to the anxiety of the occasion. The ligature was of silk prepared by steeping it for two hours in strong liquefied carbolic acid. Before applying it, the superfluous acid was removed by transferring the silk to a solution of one part of carbolic acid in thirty parts of water.

[1] *Collected Papers*, vol. ii. p. 63. [2] See page 197.

All went well. On Feb. 2nd, 1868, in a letter to his father, which begins with the description of a busy week's work, he says:

"Besides minor operations I have removed a large tumour from a young woman's back, and another from a lady's cheek, extracted a stone by lithotomy in a most difficult case . . . and last not least I have tied the external iliac artery (for the first time in my life in the living subject) for an aneurism of the upper part of the femoral artery in a respectable woman, a private patient, and in the operation I cut the ends of the ligature short, and dressed on the antiseptic system. I was encouraged to do this in spite of Appleton's[1] case not having succeeded, by an examination of the parts in the horse in which I tied the carotid, cutting off the ends of the thread. Six weeks after the operation I found the ligature still there, certainly, but surrounded on all sides by perfectly healthy firm tissue, the thread having caused none of the irritation which it does when not managed antiseptically. In order to make sure that the thread should be quite free from living germs, in the present case I steeped it for two hours in strong carbolic acid, washing out the excess of the acid before applying the ligature with watery solution of the acid. Hitherto the patient's progress has been all that can be desired: it is now more than three days after the operation, yet the pulse has not risen above 84, the tongue has been quite natural, and the wound easy; and to-day she has been hungry for the first time since the operation. I imagine there never before was a patient in so good a state at this stage after this very serious operation: we can only hope that her further progress will be as satisfactory."

These hopes were realized. On Feb. 5th he writes again to his father:

"I send just a few lines to give thee what I know will be the welcome news that the case of ligature of the external iliac continues to do as well as can be wished. I have seen the patient this morning, six days after the operation, and she is as if nothing had been done to her. Pulse 76, appetite good, sleep natural without opiate, no pain whatever, the aneurism already almost gone (absorbed) while she cannot tell where the wound is even by pressing upon the dressings. The dressing I only change every two days; and yesterday being a day for doing so, I found the discharge of the 48 hours merely a little colourless spot on the pale yellow cloth (yellow from the oil used), the result of probably 4 or 5 drops only of colourless serum. I

[1] Lister's house surgeon in 1868.

think the case may now be considered a success. I don't think any case ever excited me so much. I don't know whether I mentioned that I found reason to suppose that Appleton's failure depended on the thread not having been sufficiently imbued with the carbolic acid. He used a very *thick* thread, and I found that my own thinner silk was quite dry in its inner part after steeping for a time which I should have expected would have sufficed to soak it through and through. I therefore steeped the ligature in pure carbolic acid for 2 hours before using it and the result has been what I have said."

In Lister's letters to his father this case is referred to again and again. It evidently impressed him profoundly. The lady made a perfect recovery, but, as often happens where there is much arterial disease, she died after ten months from the rupture of another aneurism, in this case involving the abdominal aorta.

If the case had been exciting during life, it was at least equally so after death. The dissection of the part did not show what had been hoped and expected. Instead of the complete absence of irritation met with in the horse's neck, " the knot of the ligature, with two tapering ends, which were shorter than the thread was cut at the operation " was found in a tiny cavity containing a minute quantity of yellow material that looked to the naked eye like thick pus. The noose had disappeared altogether, devoured by the tissues. This was a new observation, but not one that surprised Lister, for he says, " Indeed considering the organic origin of silk, the remarkable thing seems to be, not that it should be absorbed by the living tissues, but that it should resist their influence so long." [1]

Under the microscope the yellow fluid contained a few—very few—pus cells, some fibroplastic corpuscles and some short eroded fragments of silk fibre. The result was, therefore, a disappointment, for, as he felt certain that organisms had been excluded, Lister concluded that the cause of this incipient abscess, if indeed it were an abscess at all, must have been the mechanical irritation of the " sharp and jagged fragments " of the disintegrating silk fibres.

But whatever might be thought of the explanation, it was clear that if there were even a remote chance of silk, when

[1] *Collected Papers*, vol. ii. p. 90.

used antiseptically, giving rise to an abscess, this was a serious objection to its employment. So he next turned his attention to the discovery of a more suitable animal material, one more certainly and more readily absorbable than silk; and the first that occurred to him was catgut, which, like leather and tendon, had from time to time been used for ligatures long before, but had always been given up as unsatisfactory.

Commercial catgut is made from the intestine of the sheep by a rough and ready process, and consists of what is known to anatomists as the submucous coat, that is, the part that lies immediately beneath the mucous membrane lining the interior of the bowel.

A convenient opportunity of testing the efficiency of catgut arose during the last Christmas holiday (1868) that he was destined to spend at Upton. As in the attempt with the silk, the experiment had first to be made upon one of the lower animals. A young calf was secured; his father's museum on the first floor was turned into an operating room; chloroform was given, and the carotid artery was tied in two places with catgut. One sample was home-made from the peritoneal covering of the intestine of an ox, the other was what is known in the trade as "minikin gut." It was very fine, and the first piece broke, but it was left lying round the artery by the side of a second piece, in which the knot held. The commercial gut was seasoned with age—a most important matter, as Lister afterwards discovered. The only other preparation consisted in soaking them both for four hours in a saturated watery solution of carbolic acid. I have a vivid recollection of the operation, the first at which I assisted him; the shaving and purification of the part, the meticulous attention to every antiseptic detail, the dressing formed of a towel soaked in carbolized oil; and my grandfather's alabaster Buddha on the mantelpiece contemplating with inscrutable gaze the services of beasts to men.

A month later the calf, which in the meantime had been in the best of health, was sacrificed, and the parts, carefully packed antiseptically according to Lister's special instructions, were forwarded to him for dissection.

At first sight what he found was disappointing, for the ligatures were still there, to all appearance, as large as ever. But a closer inspection showed that the appearance was deceptive. The original catgut had almost completely disappeared, and its place had been taken by a new tissue formed by the invasion of its substance by cells from the surrounding parts, in the same way as the carbolized blood clot had been replaced by new living tissue in the cases of compound fracture before described.[1]

The microscope confirmed the evidence of the naked eye. Both the new and the old tissues could be plainly seen and easily distinguished one from the other. The deceptive appearance at the first glance depended upon the fact that the new tissue corresponded exactly in shape and position to the old, and was increased by the persistence of some dark adventitious particles of mineral nature which were present in the substance of the original catgut. The colour, however, had changed from a dirty grey to a dirty pink, and at the place where the two strands of minikin gut had been left in contact with one another they had become fused together in a single fleshy band, which was inseparably blended with the external coat of the artery. The knots were nowhere discoverable.

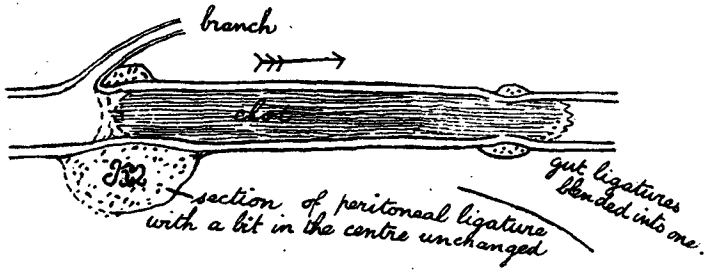
In a letter to his brother, dated February 5, 1869, he thus described the appearances, in more detail:

"I know thee will be anxious to know what I have found in the calf's neck. Well, at first on dissecting down on the artery I was much disappointed to see that the ligatures were still there, as large as ever. But on attempting to isolate them from surrounding parts, I found them inseparably blended with the coats of the artery. And further examination confirmed the conclusion that the substance of the ligatures had been replaced by living tissue, differing in character altogether from that of the gut; being fibrous tissue in process of formation, not perfect tissue like that of the gut or peritoneum. One portion of the home-made peritoneal ligature still remains unaltered, viz. the *middle* of the thick knot, as seen below in section.

The arrow indicates the course of the blood. A branch came off just by the thick ligature and prevented any clot from forming there: yet the tied part had withstood all the strain of the blood bumping

[1] See page 192.

against it. The two fine ligatures (minikin gut) are blended into one band of pink fibrous tissue; but the new tissue is tattooed with the specks of dirt of the original material, these specks having resisted the absorbing action of the tissues, being of mineral nature unfit for their food. Thus the ligatures have been served just as the compound of blood and carbolic acid was in compound fracture cases; it had been replaced by living tissue. Nothing could be more beautifully in accordance with all I have before made out, or more satisfactory *practically*. I was half afraid the gut ligature would be absorbed too quickly and leave the vessel weak at the part. But we see it permanently strengthens it."



Although the experiment with the calf was a striking success, it was soon evident that ordinary catgut was untrustworthy without further preparation, because, as Lister had feared might be the case, it was absorbed too quickly, and because, when moistened with water or with animal fluids, it became so soft and slippery that a knot tied upon it yielded to the slightest traction. These were serious defects, and would have been sources of great danger.

By a strange coincidence Lister's next method of rendering the gut antiseptic made it at the same time both stronger and less slippery. He placed it in a mixture of liquefied carbolic acid and oil. The liquefied carbolic acid contains a small amount of water, and it turned out that the, so to speak, accidental presence of this modicum of water enabled the oil to act upon the catgut in such a way as to produce a seasoning effect which made it stronger, less slippery and more slowly absorbable by the tissues.

That this change depended on the presence of the water was shown by the fact that if crystallized carbolic acid, which contains no water, was substituted for the liquefied carbolic

acid in making the preparing mixture, although the gut was rendered sufficiently antiseptic, it was left just as prone to premature absorption, and became just as slippery when placed in water or serum, as if it had undergone no preparation at all. Lister fully discusses this complicated subject in the *Collected Papers*.[1] It proved to be even more complicated than he thought at the time.

By this process an excellent and trustworthy ligature was obtained, which was sold in bottles containing carbolized oil, or kept on a winder devised by Lister, in an oil-tight silver capsule attached to the caustic-case which every surgeon in those days carried about in his pocket instrument case. It was the "carbolized catgut ligature" in common use for more than ten years.

But there were some disadvantages in this method of preparation. It took a long time. Two months was the minimum, and the results were better still if it extended over six or twelve months, or even longer. The precise temperature at which the process was conducted had also an influence upon the quality of the product. There was no security that manufacturers would attend to these details; indeed, it was only too likely that a sudden demand would lead them to disregard minute instructions, the importance of which they could not be expected to appreciate. It became notorious that samples put upon the market were not uniformly sound; and thus the only way to be sure of having a good article was for the surgeon to prepare it for himself. Few surgeons were willing or able to carry out such a troublesome process, and there can be no doubt that imperfect material accounted for some of the mishaps that were recorded.

Writing much later, in 1881, Lister said:

"Why, it may naturally be asked, has my own experience been more satisfactory with the catgut ligature than that of many other surgeons? There are, I believe, two reasons for this. One is that I have never ventured to tie an artery of considerable size in its continuity without having taken pains to ascertain that the catgut was of thoroughly reliable material; and the other reason is that I have adopted strict antiseptic means of treatment, not only during the earlier stages

[1] Vol. ii. p. 269. See also *Edin. Med. Journ.*, 1875-6, vol. xxi. pp. 193, 481.

of the case, but to the last. So long as any part of the wound remains unhealed, antiseptic treatment of the strictest kind ought, I believe, to be employed. Even though the sore may seem to be superficial, there may still exist a sinus leading down to the site of the ligature; and if ordinary treatment, as distinguished from antiseptic, be employed, down this sinus the septic process may advance and invade the ligature, and lead at last to disaster from haemorrhage. I know that this has actually taken place." [1]

Lister at once began to use the carbolized catgut freely in wounds, with complete success. The first surgeon to use it for tying an artery in its continuity was Mr. Bickersteth, of Liverpool, an enthusiastic follower and friend of Lister. In the spring and summer of 1869 he published in the *Lancet* a series of striking cases illustrating the successful employment of the antiseptic system, amongst which were some in which he had tied large arteries.

On April 20th, 1869, Bickersteth wrote to Syme:

"You will like to know what I am about, and so first of all let me tell you I am a firm disciple in the antiseptic theories and practice. This day fortnight I tied the carotid artery (for aneurism) with the antiseptic catgut ligature—cut off short, both ends—and the wound completely healed *without one drop of pus* in about 7 days—to make sure I continued the carbolic oil for 4 days more and then removed everything. The cure is complete, and I am lost in wonder and admiration at this great discovery.

The same day I tied the external iliac close to its origin—cut off both ends of the ligature, and except a few drops of thin pus which has escaped on 3 or 4 occasions, from one end of the incision, there has not been the slightest evidence of inflammatory action. This case may now also be called cured—the wound healed throughout.

I think I am the first who has succeeded with the catgut ligature on the human subject. Of course Lister has the entire credit of this great step which removes all the risks from the ligature of great arteries.

I wonder what will become of acupressure now ! ! !"

On the other hand, there were reports of failures, one of which made some stir in the medical world.

On June 5th, Mr. Spence, of Edinburgh, the successful candidate in the contest for the Systematic Chair in 1864, reported a case in which he had tied the right common carotid

[1] *Collected Papers*, vol. ii. p. 106.

with a piece of carbolized catgut procured from Mr. Syme's department in the Infirmary. The next day, during an attack of vomiting, the patient became comatose, and paralysed on the left side, and died two days later. He described how the wound was washed with carbolic acid, how he had used new sponges—not hospital sponges—and had them steeped in a weak solution of carbolic acid, and other details. At the post-mortem examination there was found no sign of constriction at the place where the ligature—not the knot—had given way, and had become so gelatinous and puffy that it seemed as if it had been cast in gelatine.

This was followed by a letter from Mr. Syme's then house surgeon, Dr. Edward Lawrie, who in later years showed himself well able to defend any cause which he espoused. He said that, being asked at the last moment for a ligature, he had sent some which were imperfectly prepared; and, after commenting on the methods adopted by Spence to prevent putrefaction, showed that suppuration actually had occurred. But, unfortunately, he made some other statements resting on less sound evidence.

For this action the Managers of the Infirmary summarily dismissed him, which naturally incensed Mr. Syme, and his dismissal was followed by the resignation of another resident at the Infirmary.

Spence wrote a very long letter to the *Lancet* dealing with Dr. Lawrie's statements, and Bickersteth continued the discussion (July 24th) by describing a simple experiment to show that properly prepared catgut will retain its strength unimpaired for a much longer period than that in which Spence's specimen was reduced to a gelatinous state.

To this Spence made a short and feeble rejoinder.

Bickersteth and Spence illustrate respectively the attitudes assumed by those who accepted Lister's teaching and those who opposed it. Spence's failure, however—or, as Lister called it, his "pitiable case"—and reports of others by competent men in which the ligature had slipped or given way, made Lister doubt the trustworthiness of his method of preparation. He set to work accordingly to try to find a better. His experiments on catgut lasted throughout the

whole of his active professional life; indeed, the very last note in what he called his "common place book" (really a voluminous record of experiments, notes and observations), dated July 25th, 1899, 1.20 p.m., breaks off in the middle of an account of a complicated research into the relative antiseptic properties of two kinds of prepared catgut.

By the year 1870 he was so confident in his method of preparation that he employed his carbolized catgut in cases which subjected it to a very severe test, and avowed "that for my own part, I should now, without hesitation, undertake ligature of the innominate [the largest artery in the body to which a ligature can be applied], believing that it would prove a very safe procedure." But after the lapse of years he owned that he looked back with horror to some of his earlier "procedures with catgut,"[1] for he did not then know how much the trustworthiness of catgut depended upon the seasoning which comes with age. This fact he picked up accidentally from an old peripatetic fiddler, who came in to amuse the patients in the Infirmary at Edinburgh, and who on one occasion said that his fiddle would not work properly because the weather was wet and his fiddle-strings were not sufficiently seasoned.

It was indeed a difficult subject. In his "common place book" for 1875 are notes of "a fresh series of experiments to test the question of the seasoning by age," amongst which, on November 29th, occurs the following reflection, prompted by the comparison of a fresh piece of carbolized catgut with one six years old:

"Hence it seems quite clear that mere long keeping in the dry state so "seasons" catgut as to make it fit for surgical purposes. The question remains, Does not our method of preparation of catgut promote this seasoning process, or accelerate the closer aggregation of particles in which I presume such seasoning process must consist? I am sorry I have no notes of my Glasgow experiments. But surely the result arrived at cannot have been altogether delusive. Is it possible that I attributed to the method what was really due to mere lapse of time? At all events it remains a remarkable fact that one piece of catgut is growing dryer and denser in the preparing liquid which makes another fresh piece moist."

[1] *Collected Papers*, vol. ii. p. 109.

Nearly a year later there is another heart-searching parenthesis amongst pages and pages of dry notes:

"Comparing *x*. with *y*. [two samples of gut], we see how utterly insufficient a test was the steeping in water on which I used to rely—on what slippery ground have I been treading! How serious a matter it was to advise a means of such doubtful efficacy in circumstances of such tremendous importance as haemorrhage or aneurism! I can only wonder that the results of the use of catgut have been hitherto as good as they have. As regards my experiments made long ago in Glasgow with catgut tied on India-rubber and kept in warm putrid serum, I can only suppose that I must have worked with old *well-seasoned* gut. And similarly in the cases of irreducible hernia in which I tied the edges of the pared mouth of the sac together, I cannot but think similar gut must have been used. If not, very rapid firm adhesion of the peritoneum must have occurred."

In the course of his endless experiments, Lister tried many substances, tannin, chromic acid, chromic alum with sublimate, bichromate of potash, and others. Not only had the texture of the gut to be tested, but also the length of time required for its absorption by the living tissues. For over-preparation was as bad as under-preparation, if not worse. Over-prepared gut was not absorbed at all and came away like a foreign body, as happened in a disappointing case, in which he had supplied a ligature to Mr. Oliver Pemberton for tying the external iliac artery.

In 1881 he recommended chromic acid and carbolic acid for the preparing medium. But his final process consisted in treating the gut with chromium sulphate and corrosive sublimate. This was in 1908. It is still probably the best of all catgut ligatures; but many other methods of preparation have been devised by manufacturers, both at home and abroad, whose wares are on the market and are more frequently used because so easily obtained. Some are no doubt excellent, others of very doubtful value.

In his address to the Clinical Society of London in 1881, which is full of the deepest interest, Lister says: "These experiments—it may seem almost ludicrous to say so—have occupied two years of my leisure in the past, some time ago; and, after being interrupted by an accidental circumstance,

have been continued in a more desultory manner since." [1] As we have seen, he was then hardly half way through his work upon catgut, and it may perhaps be asked why he should at the beginning of it have owned to so much excitement at the first sight of an absorbable ligature being replaced by living tissue which strengthened instead of weakening the artery, and why, if he thought it worth while to spend years of patient toil upon the subject, his biographer should inflict a long account upon his readers of what may appear to be a small matter. The reason is that it was by no means a small matter. It completely changed the method of arresting haemorrhage in wounds, and made the tying of arteries in their continuity a perfectly safe instead of an anxious and hazardous proceeding.

Conversation to-day with young surgeons of enquiring minds shows that they do not know that it was the introduction of the absorbable ligature which did away at a stroke with the old plan of leaving the long ends of the threads hanging out of the wounds, and that they are also unaware that this clumsy practice, except in the hands of those who practised acupressure, persisted up to the moment when catgut came into general use.

If this historical fact has been so soon forgotten it is important to state it plainly here, lest our successors should not only be ignorant of it, but unable to believe it.

It is true that, with the improvement in technique, we may now, in certain circumstances, employ fine silk or linen thread instead of catgut and cut the ends short with confidence that no trouble will ensue in aseptic wounds, but that does not detract from the importance or the far-reaching effect of Lister's discovery.

Before leaving this subject reference must be made to two misconceptions—two amongst the many—with regard to this part of the antiseptic treatment.

One was the rooted belief of some surgeons that the catgut was dissolved by the fluids in which it was bathed. It was easy to demonstrate the utter groundlessness of this assumption.

[1] *Collected Papers*, vol. ii. p. 107.

The other misapprehension may be stated in Lister's own words near the end of his address to the Clinical Society in 1881. It was depressing to find that after twenty years his clear teaching had either fallen on deaf ears or been forgotten. "I have been strangely misunderstood as having intended to convey the idea that the catgut, when it becomes organized, comes to life again. Gentlemen, such an absurd notion certainly never entered into my head; any more than, when I have spoken of the organization of a blood clot, I have meant by that expression to convey the idea that the blood clot becomes organized by its own inherent virtue. I found the term 'organization' ready to my hand; it was not a word of my invention. It had been used with reference to lymph."[1] And he then goes on to state again the actual course of events which has already been described.

In presenting Lister's work on absorbable ligatures in aseptic wounds as a whole, we have wandered far away from the later part of his life in Glasgow. A letter from Dr. John Brown referring to Mr. Syme and to the 1869 paper on the ligature of arteries, the title of which begins with the word "Observations," brings us back to the place and time.

"23 RUTLAND STREET,
EDINBURGH, Monday.

MY DEAR LISTER,

I have just finished your 'Observations.' I don't wonder the Magister is rejoiced and prophesies. You would have been happy and sad to have seen his face when he was speaking of this most remarkable paper. He understands its and your true worth—how deep and primary and powerful its principles and results are and must be. You should be and I suspect are a happy man. You will transform the whole science and practice of surgery. The reading of it has given me more pleasure than anything for long.

Mr. Syme is wonderfully well, and so good and gentle and considerate. I don't think I ever knew a better human being—one who more fulfils his 'chief end.'

We have great hopes that Alec! is to get the Chair, and Mr. Syme says with him and Turner and *you* after himself, the school may yet revive!

[1] *Collected Papers*, vol. ii. p. 118.

My love to Agnes—tell her to be humble—and thankful. Doubtless she rejoices in her own deep, quiet way at her friend's victoriousness.

Yours ever,

J. BROWN."

This undated letter must have been written in April, 1869, soon after Mr. Syme had had a paralytic stroke of some severity, from which he rapidly, though only partially, recovered. He improved so much that he was able to make a pleasant excursion to the Island of Mull accompanied by Lister, and later in the year to return to his practice and even to operate both at the Infirmary and in private. But he foresaw that his over-strenuous public life must soon come to an end, and his prophecy was no doubt the expression of a hope that Lister might take his place in Edinburgh. In the summer he decided to resign his chair, and Lister became a candidate. The canvass, though distracting enough, caused less anxiety than the last in which he had been engaged. The result seems at no time to have been really doubtful, in spite of a suggestion actively favoured by Simpson that the chair should be abolished.

There was no doubt about the wishes of the Edinburgh students, who sent him the following address with 127 signatures, begging him to become a candidate.

"DEAR SIR,

We the undersigned students of medicine of the Edinburgh University and Medical School, beg most respectfully to invite you to become a candidate for the Chair of Clinical Surgery, now rendered vacant by the resignation of our venerated Teacher, Professor Syme.

We take this step from a conviction that you are the man most capable, from your high attainments and achievements in Surgery, to maintain the dignity and renown which have been conferred upon the Chair and the University by Mr. Syme.

We believe that your researches in various departments of Science, and your contributions to its Literature, have caused your name to stand next to that of Mr. Syme amongst the living Surgeons of Scotland.

Your method of *Antiseptic Treatment* constitutes a well-marked epoch in the history of British Surgery, and will result in lasting glory to the Profession, and unspeakable benefit to mankind.

We feel sure also, that, if you are appointed to this Chair, the

benevolence of your character, and the urbanity of your manners, will speedily draw around you a large band of attached and devoted followers.

EDINBURGH, *5th July*, 1869."

Remembering former disappointments, however, Lister did not omit to apply for the allotment of some beds at the Glasgow Infirmary in case he failed at Edinburgh, for he had now almost completed the ten years which was the term of his appointment. The question of beds would have been of vital importance if he had remained in Glasgow; for in the event of the Managers not granting his request, he would again, as in his first year there, have been in the anomalous position of a professor of surgery without a hospital appointment. But there was no need of a decision on this matter, for the news of his election to the Edinburgh professorship reached him on August 18th, 1869. Amongst a few letters of congratulation that have been preserved is this characteristic one from Dr. John Brown:

"ROSO GLENLYON, Sunday.

MY DEAR LISTER,

The great and comfortable news reached this glen on Friday, it is a great happiness to all—especially to Mr. Syme, who I think would not have cared to live had the worst been taken and the best lost. It will sustain and hearten him more than anything that now is in this world could do, and it will be a perpetual comfort to you and Agnes to be what you will be to him. I am saying nothing of what it will be to the school and the general good of the world. . . . Give Agnes my love. I like to think of her coming back again the same unspoiled, quiet, faithful creature that she went.

I hope Mr. Syme has been the better of his wanderings. I have not heard since we left Edinburgh. This is a lovely noble glen. The sharp cone of Ben Lawers looking in at the window barely a mile off when it is 7. There is no thoroughfare, so the Glen is free from tourists, and its people are singularly un-modern, and well conditioned, only like the Athenians too much given to the worship of inferior gods, such as the *saaa*bath and the other mints and cumins.

Goodbye, if I wrote more I should only pain you.

Thanks for your letter which I shall read often in the sort of superstition that it may work like a miracle.

Yours and Agnes', Ever affectionately,

J. BROWN."

Within a month of the Edinburgh appointment, Lister's father, who had almost reached the age of eighty-four, became seriously ill. He had watched his son's candidature with anxiety and was delighted with the result, but added to his congratulations these words of warning: "In the prospect of your removal to Edinburgh one pleasant side to me has been the hope that thou wilt be less closely pressed upon by imperious requirements, and it occurs to me that it may perhaps be well to be cautious of entering on engagements that may offer there, to the absorption of time and attention."

In September Lister was planning a visit to London, and with this in prospect he wrote the last letter to his father which has been preserved:

"MILL BANK HOUSE, 12 Sept. 69.

MY DEAR FATHER,

Here we are once more on a weekly visit, the last perhaps that we shall pay before we become citizens of Edinburgh. We find Mr. Syme still gradually improving in strength. He went to *Newcastle* one day last week to see a patient, and was not over-fatigued: and he has within the last few days perfórmed a serious operation on a case that had baffled some other medical men, who had made futile efforts to do the thing.

We had Dr. Sharpey and Dr. and Mrs. Allen Thomson at lunch very pleasantly at Woodside Place the day before yesterday. Dr. Sharpey was very cordial: and was speaking a good deal of thee.

I shall have some good cases to tell thee of when I see thee next, which I hope will be within a week.

But we propose to defer our journey southward till the end of this week as I have several things that I wish to accomplish before going; among the rest the conclusion of my partly written paper 'On the effects of the antiseptic treatment upon hospital atmosphere.'

And now hoping to see thee in a few days, I will end this shabby letter, remaining with our united dearest love,

Thy ever affectionate son,

JOSEPH LISTER."

But there was to be no talk about good cases, or the new paper, or Edinburgh prospects. The visit south had to be hastened owing to the alarming turn the illness had taken, and a few days after he reached Upton his father died. Extracts that have been given from their correspondence

indicate here and there, though very faintly, the depth of the affection that existed between them. Lister's expressed wishes alone have prevented the insertion of others, of which there are very many, which would have shown how much they leaned each on the other for support in worldly matters, in questions requiring judgment, and in spiritual things.

His father's death removed the last of the older generation, and led to the breaking up of the family home and all the associations connected with it. When it was all over, and he had visited Upton for the last time, he wrote to a brother-in-law from Edinburgh on 24th January, 1870:

"I look back with a curious mingled feeling upon my last stay, as I suppose it was, in the old house where I was born, and on the curious inevitable scenes of partition of the property. On the whole, though that process was, I think, got through very comfortably, and there was much in our visit to make it extremely pleasant, the predominant feeling is one of great sadness. I dreamt two nights ago that I came down in the morning and was met by Papa, firm and erect and bright and beautiful as of old. He shook me warmly by the hand and kissed me as he used to do when I was a little boy. I asked him if he had slept well after his *long journey*. He said No, but that he was *quite* well, whereat I rejoiced. He had in his hand a little book which I understood contained notes of his journey! I woke and thought how interesting it would be to read notes of that journey! 'May I but meet thee on that peaceful shore' are words that are often in my mind."

THE OLD GARDEN AT UPTON.

CHAPTER XVII

PROFESSOR OF CLINICAL SURGERY IN EDINBURGH. DEATHS OF SYME AND SIMPSON

(1869-1870)

THE move to Edinburgh was made in October, 1869. After living for about six months in a furnished house, 17 Abercromby Place, Lister settled at No. 9 Charlotte Square, then one of the most fashionable and expensive parts of the city, and already a favourite resort for the leaders of the medical profession. He had to pay what he called a "most enormous sum" for it, but consoled himself by reflecting that the advantage of the situation for practice would very likely soon make up for its apparent extravagance, while "as to a garden to meditate in I reckon on getting a key of the West Princes Street Garden (in which the castle is) and that will indeed be a grand place for the purpose when I have it all to myself before breakfast."

He was justified in his expectations as regards practice. Edinburgh itself afforded a large field for pure surgery, and before long he became recognized as the leading Scottish surgeon, and had a larger private practice than at any other period of his life. Naturally there were mingled feelings on leaving Glasgow; but pleasant ones predominated. On November 12th he wrote to his brother:

"I had a *very* large attendance at my first regular lecture yesterday and got on very comfortably. A most dreary day's work was that of packing up my museum in Glasgow two days ago; and it felt more melancholy than I had expected, to think that I no longer had anything to do with the place where I have worked for the last nine years. But I am beginning to feel at home here. At lecture

yesterday I opened a large abscess connected with disease of the spine, making the case the text of doctrine on antiseptics. To-day the patient feels absence of the slight discomfort he had before the pus was let out: otherwise no difference from his former state. Yesterday's lecture excited me more than a lecture has done for a long time excepting the Introductory! I am thinking of publishing the Introductory [1] and have got it partly ready. Oh what a relief it is not to have to go out early every morning to hospital, and not to have to lecture every day. There is no doubt my position here is all that I can desire as a professional position. To-day I have received my first foreign honour! viz. a diploma making me foreign associate of the Society of Medicine of Norway."

And then he goes on to say how sad it felt not to have his father at Upton to write to about these things.

There were some discordant notes in the general chorus of regret at his leaving Glasgow, caused by the publication of one of his best known and most frequently quoted papers, "On the Effects of the Antiseptic System of Treatment upon the Salubrity of a Surgical Hospital," [2] dated from Edinburgh, December, 1869. This is the paper (referred to on page 129) in which he described the pit burials in the old cathedral churchyard adjoining the Glasgow Royal Infirmary and the noisome graves containing multitudes of coffins of those who had died in the cholera epidemic of 1849, mounting tier upon tier to within a few inches of the surface of the ground, and separated only by a basement area four feet wide from the two lowest male accident wards, one of which happened to be his.

The purpose of the paper was to show that, since the antiseptic treatment had been systematically carried out whenever it could be employed, the mortality after amputation had notably diminished in these exceptionally unhealthy wards, while pyaemia and hospital gangrene had disappeared, and erysipelas was almost completely banished from them. Incidentally he mentioned that this happy result had been obtained *before* the cause of their unhealthiness had been discovered, and it was important to his argument to add that no similar improvement had taken place in the other corre-

[1] Published in pamphlet form. Also in the *Collected Papers*, vol. ii. p. 977.

[2] *Lancet*, 1870, vol. i. pp. 4, 40. *Collected Papers*, vol. ii. p. 123.

sponding surgical wards. Whether this was a reflection upon the work of any of his former colleagues may be judged from his actual words:

"The wonder now was, not that these wards upon the ground-floor had been unhealthy, but that they had not been absolutely pestilential. Yet at the very time when this shocking disclosure was being made, I was able to state, in an address which I delivered to the meeting of the British Medical Association in Dublin, that during the previous nine months, in which the antiseptic system had been fairly in operation in my wards, not a single case of pyaemia, erysipelas, or hospital gangrene had occurred in them; and this, be it remembered, not only in the presence of conditions likely to be pernicious, but at a time when the unhealthiness of other parts of the same building was attracting the serious and anxious attention of the managers. Supposing it justifiable to institute an experiment on such a subject, it would be hardly possible to devise one more conclusive." [1]

This nettled the Directors of the Infirmary and one at least of his former colleagues. The Directors naturally did not like the world to think that theirs was a particularly unhealthy institution, which indeed was not what Lister had said. His statement was that his own wards had been "converted from some of the most unhealthy in the Kingdom into models of healthiness." There were two other passages to which they took special exception, dealing with the number of beds in his wards in the pre-antiseptic days and the omission of the annual cleaning when the antiseptic treatment was in full swing. He had said:

"At this period I was engaged in a perpetual contest with the managing body, who, anxious to provide hospital accommodation for the increasing population of Glasgow, for which the infirmary was by no means adequate, were disposed to introduce additional beds beyond those contemplated in the original construction. It is, I believe fairly attributable to the firmness of my resistance in this matter that, though my patients suffered from the evils alluded to in a way that was sickening and often heart-rending, so as to make me sometimes feel it a questionable privilege to be connected with the institution, yet none of my wards ever assumed the frightful condition which sometimes showed itself in other parts of the building, making it necessary to shut them up entirely for a time." [2]

[1] *Collected Papers*, vol. ii. p. 124. [2] *Collected Papers*, vol. ii. p. 124.

The other passage which gave offence was as follows:

"I may add that my wards have remained during the three years without the annual cleaning, which used to be thought essential. On my asking the superintendent the reason for the omission, he replied that, as those wards had continued healthy, and there was nothing dirty in their appearance, it had seemed unnecessary to disturb them. Thus the wards have been in various respects subjected to greater trial than usual, and yet have remained, as I may repeat without any exaggeration, models of healthiness."[1]

On January 20th, 1870, there appeared in the *Lancet* a letter[2] which had previously been communicated to the *Glasgow Daily Herald*, evidently medically inspired, though signed by the Secretary of the Infirmary, flatly contradicting some of Lister's statements, severely commenting on others, putting forward statistics to show that the mortality after amputations was less in the Royal Infirmary at Glasgow than in that at Edinburgh, and generally stating that

"in their opinion, which is shared by those of their number belonging to the medical profession, the improved health and satisfactory condition of the hospital, which has been as marked in the medical as in the surgical department, is mainly attributable to the better ventilation, the improved dietary, and the excellent nursing to which the Directors have given so much attention of late years."

Obviously this could not be passed by in silence, because, as Lister said, if it remained unanswered, it might shake the faith of the profession in his testimony. In his reply, which appeared in the next number of the *Lancet*[3] and also in the *Glasgow Daily Herald*, he was able to substantiate the truth of all he had said except in regard to one insignificant detail of ground levels. Some statements of the Directors gave him the chance of refuting a malignant anonymous falsehood that had been widely circulated, and of emphasizing the important fact that, though, under the antiseptic treatment, some patients might be kept a very long time in hospital, the total number of admissions need not necessarily be diminished.

With regard to the first of these matters he said:

"There is one point with regard to the figures given in the letter which is extremely satisfactory to myself—viz., that they serve

[1] *Collected Papers*, vol. ii. p. 134.
[2] *Lancet*, 1870, vol. i. p. 175.
[3] *Lancet*, 1870, vol. i. p. 210.

to contradict, on competent authority, an anonymous statement which was made some time ago in one of the medical journals, and has been repeated *ad nauseam* in various quarters, implying that the use of antiseptic measures in the Glasgow Infirmary had led to an increased mortality. This statement, which was said to be founded upon the hospital records, I could hardly have contradicted, although it was entirely the reverse of the truth as regarded my own department, without appearing to cast a slur upon the practice of my colleagues. But I rejoice to find that, taking the results of the practice of all the four surgeons of the hospital, the death-rate during the three years of the antiseptic period has been less by fully one-fifth than during the five previous years."

With regard to the second point and the confessedly unfortunate word "contest," he said:

"When speaking of the struggle above mentioned as a contest, I intended nothing disrespectful to the managers. Each party had a laudable object in view. They desired to accommodate as many patients as possible, while I was very anxious that those who were admitted should have favourable atmospheric conditions; and these two laudable objects were for a time antagonistic.

In this connexion the letter proceeds to speak, with what relevancy I do not understand, of my keeping patients longer in the hospital than other surgeons; and it is stated that, in my male accident ward (24), which is that to which I have especially referred, only about two-thirds of the number were under treatment that were admitted into the corresponding ward (23) on the same floor. In making this statement, the author of the letter has strangely overlooked the fact that . . . Ward 23 contains twenty-one beds, while Ward 24 has only fifteen; a difference in accommodation which nearly accounts for the differing numbers of the patients.

Had the proportionate numbers been still less in my ward, I should not have been surprised, because the great mortality which Ward 23 at one time presented led to the premature dismissal of patients in a way most undesirable. But the fact that a nearly equal number in proportion to the beds were treated in my ward, in spite of the long detention of some cases of serious injury which, but for the antiseptic treatment, would have received a too early dismissal, tends to prove, what I have long believed, that the rigid enforcement of the antiseptic principle, by hastening the cure of the majority of the patients, more than compensates for the long detention of exceptional cases.

Some abscesses connected with diseased bone, treated in the chronic and female wards, certainly proved extremely tedious, and severely tried my patience, as well as that of the managers. But

I have the satisfaction of knowing that several persons, once affected with suppuration of the hip-joint or vertebrae, are now useful members of society, who would, as I believe, have been most of them long since in their graves had I not perseveringly carried out the antiseptic treatment."

The letter was written in most courteous terms, and emphasized his regret at appearing to be in collision with a body of gentlemen for whom he entertained sincere respect and from whom he had always received consideration and kindness; but he spoke with justifiable severity of the medical men who had abetted if not inspired the letter of the Directors.

It will be remembered that the Directors had attributed the improvement in the healthiness of the hospital to improved dietary, better ventilation, good nursing and so forth, and had claimed the support of their medical colleagues in making this suggestion. To this Lister replied:

"I cannot believe that the author of the letter has here represented faithfully the sentiments of the medical members of the board of management. Some of them have, to my knowledge, a very different opinion of the antiseptic treatment from that which is implied in the above passage. And to suppose that the kind of change which I have described as having taken place in the salubrity of my wards can be attributed to the causes referred to, is simply out of the question. As regards the ventilation of those wards, it remains precisely as it was, with the exception of a freer access of air to the back of the hospital, in consequence of taking down the high wall, as mentioned in my paper; and this was not done till my patients had been already for nine months perfectly free from hospital diseases. As to nursing, my department was not affected by the change that occurred. I was fortunate enough to have excellent nurses from the commencement of my connexion with the infirmary, and I continued to have such to the last. And as to the dietary, the idea that a mere improvement in rations would abolish pyaemia, erysipelas, and hospital gangrene, is one which would hardly enter the mind of an intelligent medical man."

In the same number of the *Lancet* that contained the letter of the Directors, there appeared the first part of a long address by Dr. James Morton,[1] then Professor of Materia Medica at Anderson's University, and, not long before, Surgeon to the Glasgow Royal Infirmary. In it he said that "Pasteur's

[1] *Lancet*, 1870, vol. i. p. 155.

theory in regard to the existence of certain spores or germs in the air" had not been satisfactorily proved. He sneered at the idea that, even if they did exist, they were injurious and caused "suppuration of a bad kind"; and, by the records of a number of cases treated in different ways, attempted to show that there was little if any value in the antiseptic treatment. It is interesting as showing how one of Lister's colleagues, working under the same roof, completely misunderstood the situation. From this point of view, and from this only, it is worth reading. Morton, we are told elsewhere, never had the curiosity to enter Lister's wards to ascertain how the treatment was actually carried out.

Possibly the comment of one of Lister's friends on these two attacks was not very wide of the mark. "I can only say that there is one thing you have not accomplished in the antiseptic treatment—you have not discovered that it was the invention of a 'Glasgow bodie.' If you had, how very perfect it would have been." In a private letter written in 1915, Sir Hector Cameron says, "It is a curious instance of the 'whirligig of Time' that the present Managers consider the old connection with Lister the first feather in their cap, and proudly refer to it on all occasions!"

The episode, though unpleasant, was not altogether to be regretted. It was impossible to doubt who had had the best of the argument. It gave Lister the opportunity of re-stating in the most convincing way how much the introduction of the antiseptic treatment had improved the sanitary condition of his Glasgow wards. Moreover, the statement appeared in the most attractive part of the medical journals—the correspondence columns—which even casual readers seldom fail to peruse, whatever else may escape their attention.

We must now proceed to take a closer view of Lister's widened prospects in his new sphere of activity.

Ten years had made changes in the personnel of the University. Many of the chairs were now held by his contemporaries, but some of the old guard were still at their posts. The two most outstanding personalities, Syme and Simpson, had both received unmistakable warnings that their warfare

was accomplished. Simpson, in spite of terrific attacks of angina, continued to do the work of three men, but his phenomenally active career came to an end in May, 1870, at the age of sixty. Syme, who had shaken off much of his work after his first paralytic stroke, was seized by a second in April, 1870, and a third in May. There followed several painful weeks of slow decline, during which he was lovingly attended by his children. He died on June 26th.

The removal of these two men, as it were cleared the atmosphere of the medical world in Edinburgh, and in very different ways affected Lister's position there. Syme and Simpson had for the most part been in conflict, and each had so many devoted followers that it was not easy to avoid being a partisan of one or the other. This led to a cleavage in the ranks of the profession and some bitter feelings, which only gradually declined after the disappearance of the protagonists.

This is not the place to attempt to form an estimate of Simpson's character. Few men who could claim so many friends had so many detractors. For the former he was the embodiment of all the virtues; the latter were unable to speak of him with moderation. We have already seen the position which he took up with regard to Lister and his work, and the way in which he conducted his opposition. If he had lived longer and they had been constantly thrown together in University and Civic affairs, it is hardly to be supposed that further causes of friction could have been avoided. Simpson was one who entered into such contests *con amore*; to Lister they were repugnant and distressing in the highest degree.

The death of Syme was an unmixed sorrow. Coming, as it did, soon after that of his own father, it emphasized the fact that the last link with the preceding generation was severed. It was one of Lister's characteristics to admire some men with a whole-hearted devotion that hardly admitted the possibility of faults, and Syme was conspicuously one of these. In the *Scotsman* of June 28th, 1870, there was an obituary notice, the authorship of which was attributed to Lister, and was never disowned by him. It is, at all events, just such an estimate of Syme's character as we know that he had long ago formed and had found to stand the searching

test of years of the closest intimacy. It ends with the following words:

"The hostility which he excited in a few was greatly outweighed by the friendship he inspired in the many. Rarely is it granted to any one to attach to himself the enduring love and admiration of so large a number of his fellow-men. This was due not only to his perfect genuineness of character, which could not fail to gain respect even from those who differed from him, but also to another quality, as essential as truthfulness to a good surgeon—a most warm heart, a true love for his fellow-creatures, and a general appreciation of sterling merit in whatever form it might present itself. Mr. Syme, in short, besides being a surgical genius of the highest order, was a perfect gentleman, and a good, as well as a great man." [1]

Lister had trusted much to Syme's advice, especially when sound judgment was required; he had also had the greatest respect for his professional opinion. There were few now left whom he would care to consult on surgical matters, for he had a sturdy faith in his own diagnosis and conclusions as to treatment. But Syme's death had a yet more important result. As long as he was alive, his surgical instinct, skill as an operator, wide experience and great reputation, caused him to be recognized as the first surgeon in Scotland. Lister now, by common consent, stepped into his place.

Amongst those who were already prominent when Lister left Edinburgh for Glasgow, there was no more striking figure than that of his old friend Sir Robert Christison, the celebrated toxicologist and physician. He was now seventy-three years of age; tall and upright, with snow-white hair and remarkably alert in mind and body—a man whom the stranger stopped to look at in the street, and having once seen did not easily forget. He had been a professor since 1822, and was destined to take an active part in the affairs of the University till 1881. He and his friend Douglas Maclagan, *par nobile fratrum*, were not only valued in council, but, with their genial characters and musical talents, were welcomed at social functions both public and private.

[1] *Memorials of the Life of James Syme*, by Robert Paterson, M.D., Edinburgh, Edmonston & Douglas, 1874, p. 327.

Lister's colleagues on the surgical staff included Patrick Heron Watson, his former fellow-student, well known for his surgical dexterity; and James Spence, his successful opponent for the chair of Systematic Surgery, a solemn and somewhat unsympathetic individual, but a good surgeon. Of his contemporaries, William Turner, when these words were written Principal of the University, Matthews Duncan the great gynaecologist, and Thomas Keith (generally known as Tom Keith) the pioneer in ovariotomy, were perhaps his closest friends. On the junior surgical staff were Annandale and John Chiene, who in turn succeeded to the chair of Clinical Surgery; John Duncan, a most intelligent disciple; and Joseph Bell, whose surgical attainments were somewhat overshadowed by qualities which are said to have suggested Conan Doyle's mythical popular hero Sherlock Holmes. It is only necessary to mention the names of Grainger Stewart, Laycock and Fraser to show that the physicians were at least equally eminent. And in the other faculties there were men of world-wide reputation, such as Blackie the picturesque and poetical Professor of Greek, Crum Brown the chemist, and Archibald Geikie the geologist, who has risen to the highest position in the scientific world. These few names are mentioned—and that of Dr. John Brown must not be forgotten—in order to give some idea of the circle in which Lister now found himself. It was a self-contained, highly intellectual University circle—somewhat cliquish no doubt, but becoming less so. The conflicts of the past were not completely forgotten, but a calmer and more charitable spirit was descending upon Edinburgh, as well as upon the rest of the scientific world. Doctors, at all events, were becoming accustomed to the idea that it was not only possible, but far best, to conduct their discussions in moderate language unblemished by personalities. And thus, Edinburgh had become a pleasanter place than of old; indeed a very pleasant place for one who was engaged in working out a scientific problem and demonstrating its practical application.

Fifty beds at the Royal Infirmary afforded an ample field for clinical work. The dingy old building would have shocked the refined senses of our aesthetic hospital experts. According

to modern notions, the wards were far too crowded, but Lister's confidence in his methods was so great that he no longer protested, indeed he winked at the fact, when shake-downs were put between the beds on the floor at night. There were no snow-white coverlets, no steam sterilizers, no glass dressing tables, no prim nurses with spotless uniforms.

The nurses were probably at least as good as in most hospitals that had not come under the direct influence of Florence Nightingale or her pupils. Educated women had hardly begun to diffuse their leaven in the nursing profession. The fully trained nurse was hardly known, and some of the old "Sairey Gamp" type were still to be met with. Lister used to tell of one of these who took advantage of an empty bed to sleep off her potations. Instead of being instantly dismissed, as would be the case now, it was suggested that the effect of a serious reprimand from her surgeon should be tried. Accordingly, he put on his gravest expression—and he could be very grave at times—and asked her whether she never thought of her responsibility for all the poor sufferers under her charge. "Oh, I nae minds o' *them*" was her unexpected reply, which, with its cheery indifference, nearly upset his gravity.

But there was one amongst them, Mrs. Porter, a great character, who might almost be called an institution. She was head nurse in his wards, as she had been under Syme's régime. Edinburgh students of those days remember her well. She kept them all in order, and, it was said, her chiefs also. She acted as if all the responsibility rested on her shoulders, and was in fact an important and efficient personage, whom everyone treated with deference. She had taken Lister under her special protection when he was a student, and was delighted to see him back again. Dr. Beddoe, the anthropologist and Crimean veteran, in his fascinating *Memories of Eighty Years*, gives a picture of her in those old days on the occasion of an escapade which might well have cost Lister his life. He and Lister had been fellow-students in London and foregathered again at Edinburgh. Beddoe, who was a lively and enterprising young man, persuaded Lister that a feat not to be omitted was to climb up a rather dangerous cleft in Salisbury Crags, called the Cat's Nick, as many dis-

tinguished men before them had done. So one day they made the attempt, which he thus describes:

"Lister had been overworking himself, and before I, who was leading, had accomplished more than half the ascent, he said to me—

'Beddoe, I feel giddy; would it not be foolish in me to persevere to-day?'

'Certainly!' I replied. 'Let us postpone it till you are in good condition,' and I began to descend.

I suppose much experience of the place had made me careless. A large fragment came away in my hands, and the stone and I both fell upon Lister. He was looking up at the time, and squeezed himself cleverly against the face of the cliff; but the huge stone struck him on the thigh with a grazing blow, and then whirled down the talus below with leaps and bounds, and passed harmless through the middle of a group of children who were playing hopscotch at the bottom right in its way.

Lister was badly bruised, but no bone was broken. I went off at once to the Infirmary and procured a litter and four men, wherewith I returned to Lister. As our melancholy procession entered the courtyard of the surgical hospital, there met us Mrs. Porter, the head nurse then and for many years after. She wept and wrung her hands, for Lister was a universal favourite.

'Eh, Doketur Bedie! Doketur Bedie! A kent weel hoo it wad be. Ye Englishmen are aye sae fülish, gaeing aboot fustlin' upo' Sawbath.'

I do not suppose Lister ever whistled on Sunday. I am certain I did not, for I never could whistle in all my life; but we had suffered for the national offence. We were both in bed for a fortnight."[1]

The giddiness to which Beddoe refers had probably nothing to do with overwork, as Lister never had a good head for perilous places.

Henley, the author and poet, was a patient in Lister's wards in 1873, and while there wrote some short verses, which he called "In Hospital: Rhymes and Rhythms." One of the best of these, "Staff-Nurse: Old Style," hits off Mrs. Porter with a masterly touch:

"The greater masters of the commonplace,
REMBRANDT and good SIR WALTER—only these
Could paint her all to you: experienced ease
And antique liveliness and ponderous grace;

[1] *Memories of Eighty Years*, by John Beddoe, M.D., LL.D., F.R.S., Bristol, J. W. Arrowsmith, 1910, p. 55.

The sweet old roses of her sunken face;
The depth and malice of her sly gray eyes;
The broad Scots tongue that flatters, scolds, defies;
The thick Scots wit that fells you like a mace.
These thirty years has she been nursing here,
Some of them under SYME, her hero still.
Much is she worth, and even more is made of her.
Patients and students hold her very dear.
The doctors love her, tease her, use her skill.
They say 'The Chief' himself is half-afraid of her." [1]

University life was not so strenuous at Edinburgh as at Glasgow. It involved much labour, but was less exacting. The hospital visit at mid-day was less irksome than the early morning visit had been. No doubt it interfered with domestic arrangements, for Lister did not leave till every conceivable duty had been religiously fulfilled, often returning to a belated lunch in the middle of the afternoon. With him the next occupation, however important or attractive, had to wait for the completion of the present duty; thus meal-times were movable feasts, completely disorganized by the urgency of exciting experiments, and bedtime might be postponed till four or five in the morning while elaborate notes or delicate *camera lucida* drawings were brought to a conclusion.[2] The

[1] *A Book of Verses*, by William Ernest Henley. London, David Nutt, 1888.

[2] This note from the "common place book" in Mrs. Lister's handwriting is characteristic. Lister was at the time interested in the development and movements of bacteria. It was already long past midnight.

"23rd Dec. 1871, 2.55 a.m. A drop from the upper part of (10') shows bacteria in full activity, both as free individuals and as dense swarming masses. In watching the movements, while the wriggle that causes the outward motion is often quite apparent, it is often so rapid as to be invisible, (like the movements of Bosco's hands) when the bacterium is seen to forge ahead in an apparently rigid form, one end foremost, like an arrow from a bow. But that the wriggling movement does exist may be safely inferred from the imperceptible gradation from slow wrigglings through a wide angle to excessively rapid but minute quiverings and thence to invisible motion."

Another note follows in the same handwriting at 3.50 a.m., and then it may be assumed that the amanuensis had at last retired. Not so the experimenter, for his last entry for the night is 4.30 a.m.

The following letter from Mrs. Lister to a sister-in-law, after telling of one of Lister's many foreign honours, graphically described the hurry in which they lived at this time.

"Joseph has had a very cordial letter from Leipzig, from the professor

uncertainty of the length of the hospital visit was trying to the students, who knew well enough how quickly Lister could act when it was necessary, and thought, like hungry young men, his minute attention to details sometimes superfluous. But if there were signs of impatience "the Chief" did not notice them. Each antiseptic case had to come under his own personal observation. Such personal attention was essential in these early days, but was not to be expected of surgeons who took no particular interest in the matter and were certainly not fired by his great enthusiasm. It is no wonder that so many failed to obtain his results, and suggested that his success was due rather to supervision than to the principle upon which his practice was based.

In Edinburgh the purely academic duties, also, were less onerous. The delivery of two clinical lectures a week was a pleasant contrast to that of the daily systematic lecture at

of medicine, telling him that the diploma of their Medical Society as an honorary member has been sent to him.

I had better copy part of the letter. 'Die Mitglieder dieser Gesellschaft nehmen es sich zur hohen Ehre an, die seit dem Tode des hochberühmter William Lawrence erledigte Stelle eines Ehrenmitgliedes aus der Mitte der Englischen Chirurgen, durch den Mann wiederbesetzen zu können, der sich durch Einführung des antiseptischen Verfahrens so hohe Verdienste um Wissenschaft und Praxis erworben hat. Dieselben geben sich der freudigen Hoffnung hin dass Sie, hochgeehrter Herr, geneigt sein werden dieses Diplom als einen Beweis der dankbaren Anerkennung dieser Verdienste zu betrachten und freundlich anzunehmen.' [The members of this Society esteem it a great honour to be able to refill the position of English surgical honorary member which has been vacant since the death of the distinguished William Lawrence, by the man who has laid both knowledge and practice under so great an obligation by the introduction of the Antiseptic Treatment. They indulge in the sanguine hope that you, honoured Sir, will agree to look upon this Diploma as a proof of their thankful recognition of this obligation, and graciously to accept it.]

We think from the way in which this is expressed it must mean that they have only one honorary member among British surgeons, and that this place has been vacant since Sir W. Lawrence died; so that it is the highest honour the medical profession in Leipzig could bestow upon a surgeon in this country.

I am writing now on the 10th inst—Joseph has only just come from the hospital at 4.15! and we are going to have lunch! He has had to perform two amputations at the Infirmary and on coming home finds people waiting for him, (there was only one party) whom he is seeing now without having had lunch. He has an operation in private at 4.30! and three patients to see afterwards. Dr. Bishop is in bed with bronchitis. Joseph had an operation here before going to the hospital. So it has been a busy day."

[Dr. Bishop was his private assistant.]

Glasgow. On lecture-mornings Lister was accustomed to sit quietly thinking for half-an-hour in his arm-chair, during which time he must not be disturbed. No other preparation was needed.

The lectures were effective and inspiring, very different from the ordinary perfunctory clinical lectures at other places given from time to time by each member of the staff, which, not being compulsory, were seldom well attended. In Edinburgh the course of clinical surgery formed a part of the regular curriculum, and students had to be signed up for their attendance. But they often took out a second course which was not required of them. The class was enormous, as the entry of new students was sometimes 170 or 180 in a year. The capacious operating theatre, seated for four or five hundred, such as may still be seen in America, but seldom now in this country, was packed up to the top row. There was a large "area," or ground space, surrounded by chairs for a dozen or more distinguished visitors, which were often all occupied. Four dressers, in blue check aprons, brought in the patient on a long wicker basket, and placed him on the table. The notes were read by the clerk, and the Professor proceeded to discourse in deliberate and clear language, without show or ornament, but rendered piquant by a very slight stammer and an occasional flash of quiet humour. The special feature of Lister's lectures was that they did not consist so much in a description of the particular pathological condition from which the patient was suffering, or the clinical details of diagnosis or treatment, as in eliciting from each case some fundamental lesson of far-reaching application. He was therefore not at great pains to seek out examples of obscure disease. An ulcer of the leg, an old dislocation, a chronic abscess, served his purpose equally well, or even better. The lectures gave what no book could supply, and for this reason were never tedious, but held the close attention of the students. And though some might regret that so many paths led up at last inevitably to the antiseptic doctrine, it was found, by the end of the session, that a large part of the surgical field had been gone over in travelling there. In the course of a single lecture perhaps three or four patients

were brought into the theatre; and sometimes, but not always, an operation was performed upon the last, which gave the opportunity of explaining the principles underlying the mechanical art of surgery.

Notes of lectures so largely demonstrational can give no idea of their excellence. It is the personality of the teacher and that which strikes the eye which impress the student far more than the spoken word. However, those who wish can see the original notes of the course of 1872-73, taken by Sir Watson Cheyne, then Lister's house surgeon, and placed by him in the Library of the Royal College of Surgeons of England.[1]

[1] See also Appendix.

CHAPTER XVIII

EARLY BACTERIOLOGICAL WORK. FIRST CORRESPONDENCE WITH PASTEUR (1870-1874)

THROUGHOUT his professional life Lister made it a point to be provided with a trusted assistant, to whom the after care of his private patients was largely confided; and thus, in spite of the increasing number of his engagements, he found, or made, a good deal of time for scientific pursuits. Amongst these must be included the working out of new surgical problems; that is, the devising of such new operations as the increased security afforded by the antiseptic treatment rendered possible. It became a matter of conscience, as well as an exciting pleasure, to open up these new fields of surgery. He felt a moral obligation not to deprive his patients of the benefit of operations which he was convinced were safe, even though the unconverted, who still formed the majority of the profession, might consider them unjustifiable. This pioneer work led to interesting situations and striking triumphs, but it involved many anxious times and, it must be owned, a few disasters. It was almost impossible that it should have been otherwise; and, as was natural, the account of any mishap was exaggerated and bruited abroad by those who did not believe Lister's teaching, and were therefore disposed to belittle his achievements. Surgery is said to resemble war, in which the most successful general is the one who makes the fewest mistakes. Even the most careful, even the most timid surgeon, cannot hope altogether to prevent what have been called "surgical catastrophes," however strictly he may follow the recognized

rules of practice; much less is a pioneer likely to escape them whilst breaking altogether new ground. Lister was by no means a timid surgeon, and whenever such an incident occurred, indeed whenever a patient caused serious anxiety, he felt it very acutely at the time. But when the crisis was over he could shake off the depression, and put what was irremediable behind him perhaps more quickly than some less sensitive natures. With him the lesson was learned, the pitfall would in future be avoided, but useless remorse was not allowed to interfere with the next step forward. He had thought out each problem with such care, and was so conscious that he had done his best, that he was able to feel a large measure of that spiritual support in which his upbringing and his early surroundings had accustomed him to trust.

Besides these pressing surgical problems, three matters at this time particularly occupied his thoughts. Two were important modifications of method in carrying out the antiseptic treatment. They will be discussed in the following chapter. The third was a series of investigations into the life history of fungi and bacteria, and their relation to fermentative processes.

These enquiries, closely associated with the main object of his life, and inspired by the writings of Pasteur, were his recreation, if recreation is the word for a pursuit of knowledge so laborious and so indefatigable. They gave a special object to country rambles, crowded his laboratory with vessels of cultivating media, and filled his "common place book" with notes and drawings.

For such studies Lister was well prepared both by inclination and education. As a student he had been inspired by Lindley's teaching, and was clearly disappointed and even surprised when he learned that botany was his weakest subject at a University examination.

In August 1850 he wrote to his mother:

"Having just been to Somerset House to enquire my unpublished fate, which one gets to know by paying a shilling to the porter (who gets the list this afternoon :) I write at once to let thee know that I am in the first division.

I enquired at the office what subjects put me in the first division; (for the examiners met to-day and each one may either reject or put in the first division) and I found that all *except Botany* were for putting me in the first division. I think perhaps I know how it is that I missed it in Botany; one thing I know that I very much prefer knowing Botany the subject I was worst in to its being any other, for it is far the least important, and I know that I have some knowledge of Botany."

Field botany was always a favourite pursuit, and packets of pressed flowers were the invariable and much prized trophies of foreign tours. His interest in structural botany had been recently revived, partly by helping some of the younger generation in their studies, but more especially by the important investigations of his brother Arthur, who, after working for some years at the higher fungi, had begun to specialize on the myxomycetes, and was already a recognized authority on the subject. The rhythmic movements of these strange creatures, and the extraordinarily rapid changes they undergo, from an unorganized plasmodium into structures of great complexity and extreme beauty, excited Lister's keen interest. He hoped to gain some light from them upon his own studies, and many letters passed between the brothers on this and kindred matters.

Thus on January 5th, 1872, he writes:

"I have got three plants of the 'creepy-crawly' [*Badhamia utricularis*] growing under three glass shades, one has the bit of wood that came from Leytonstone simply on a glass plate under the shade with some water to keep it moist. This one is to-day a beautiful *pure yellow*, and arranged in threads and globes, *just* like the ripe Badhamia except the colour.

Now I want *very* much another specimen, as this is too old to get on the glass for examination. Indeed one specimen is already getting *dark* brown almost black, having been yellow last night. I want much to see it again as a moving thing."

And then he goes on to suggest the best way of packing it

"so that the beast may not crawl off upon the box during the journey."

On February 2nd, 1872, he says:

"I have been labouring hard, I may say, at the subject of these wee organisms, and have made *some* progress. But though the

notes fill many and many a page of the book that thee sometimes kindly wrote in, the results are small indeed. I have made the acquaintance, I think I may say, of two definite new atmospheric organisms, capable of inducing putrefaction in urine. But that is nearly the sum of my results.

I have been striving to filter water of bacteria germs, but hitherto without complete success, though apparently most tantalizingly near it.

Now I have determined to take up the yeast plant again at the point where I left it at Leytonstone [where he had been spending Christmas with his brother] and, as no German yeast can be got in Edinburgh, I should be extremely obliged if thee would despatch me a packet by post, say wrapped in tin foil.

To show that I am *working*, I may say that on my mantelpiece are 19 glasses, most of them under separate glass shades, all put up since my return, and only a small number of those that have been there."

The disproportion between effort and result is mentioned again on February 25th, 1872.

"I am terribly busy snatching time whenever I can get it, for work at the organisms. But though I never work at the subject without getting some new and interesting fact, yet when it is all put together the sum of my product seems a very insignificant affair."

In the next letter, dated March 31st, 1872, he explains how he was led to make the investigations which formed the basis of two papers which will shortly be described.

"I have distinctly proved that two kinds of bacteria grow from two fungi, one of these fungi being the torula cerevisiae! But neither of these bacteria seems to be the commonest kind. Though indeed, for aught I know to the contrary, there may be *many* kinds each from its own kind of fungus. But meanwhile it is a great point to have clearly established that there are two totally distinct sorts and that they grow from fungi. The yeast plant presents a good example of the kind of modifications fungi are liable to from differences of circumstances such as thee say are alluded to in Berkeley's book. Will thee please tell me exactly its title that I may order it?"

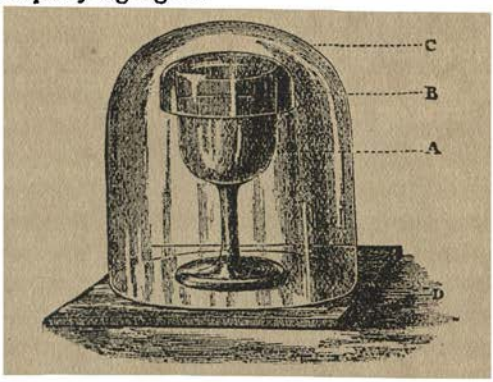
The amount of time and labour which Lister devoted to bacteriological study was indeed enormous. It is recorded in four or five hundred closely written foolscap pages, embellished by hundreds of delicate camera-lucida drawings.

Some might doubt, as he himself was evidently at this time inclined to doubt, whether the time was well spent; for, as these letters show, he sometimes, like other explorers, went astray. But much good came of it, for he was on a voyage of discovery and, in the course of the experiments, he was constantly devising new methods and inventing ingenious apparatus for obtaining pure cultures of micro-organisms, which were freely made known and adopted by other observers. At last he reached as near to perfection, both in respect of accuracy and simplicity, as was possible so long as fluid media alone were employed for the cultivation of micro-organisms. Lister's was the only recognized method up to the time when the introduction of Koch's solid media simplified the whole procedure, while rendering it much more accurate. Even if this had been the only result the time would not have been wasted, for these mechanical difficulties had to be overcome before it was possible to isolate particular organisms and to study their life history, which is the foundation of all bacteriology. The account of Lister's perfected method of experimenting, which is fully described in his address On the Lactic Acid Fermentation and its bearings on Pathology,[1] is good reading for practical surgeons. It is still more instructive to follow in his note-books the steps that led up to this complicated technique. For the same difficulties beset both bacteriologists and surgeons; but, while the failures of bacteriologists lead only to disappointment, a surgeon's mistakes may be disastrous.

As an illustration let us take one or two of these technical points which are of more general interest. The reader will not have forgotten the flasks with twisted open necks, and their perilous journeys from Glasgow to Edinburgh and from Edinburgh to London. They suggested to Lister a convenient method for preserving fluids from contamination from dust, while at the same time permitting the introduction of organisms it was intended to cultivate, or the abstraction of portions for microscopical examination. Profiting by Pasteur's experience and his own, that dust cannot follow

[1] *Transactions of the Pathological Society of London*, 1878, vol. xxix. p. 425; *Collected Papers*, vol. i. p. 353.

tortuous routes, he adopted the simple arrangement shown in the accompanying figure.



The liqueur glass *A* with its glass cap *B* have been sterilized by superheating. Not so the piece of plate glass *D* on which it stands, nor the bell glass *C* which covers it. Yet he was able to say:

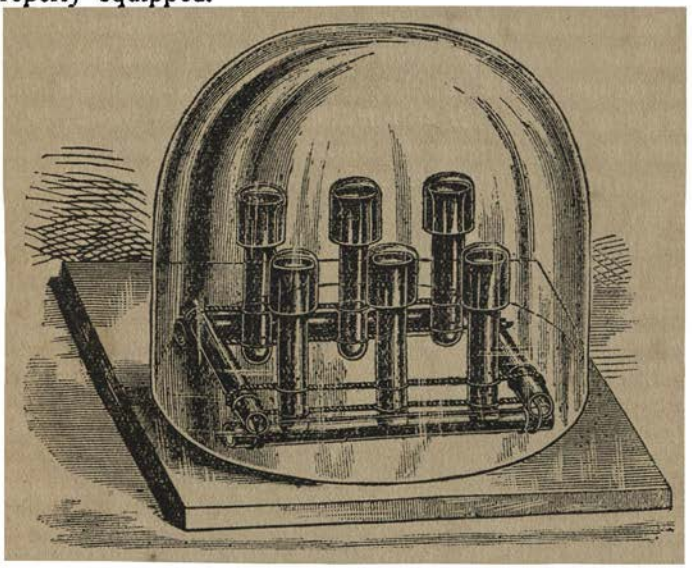
"Experience has now amply demonstrated . . . that any organic liquid contained in the liqueur-glass, provided it be free from living organisms at the outset, will remain without any organic development occurring in it as long as the arrangement of the glasses is left undisturbed. Or, in other words, although an interchange is constantly taking place between the gases of the atmosphere and those in the liqueur glass—for the cap does not fit at all, and the shade is not air tight—yet the double protection of the glass cap and the glass shade effectually prevents access of the atmospheric dust to the liquid; and if the dust is excluded, organisms do not occur in it."[1]

Rows of these liqueur glasses containing fluids of many colours formed at this time an attractive feature of the study from the aesthetic as well as from the scientific point of view; and this was not diminished when six miniature test tubes replaced the single liqueur glass under the glass shade, as is shown on the next page.

The superheating was effected in what was known as the "hot box," which is figured and described in the same paper. A much more primitive form is described in the "common place book." In the early experiments each glass was

[1] *Collected Papers*, vol. i. p. 354.

heated in the flame of a lamp, a difficult and tedious process. In the large "hot box" a uniformly diffused dry heat of 300° F. was obtained, and many vessels could be superheated at once. This was the beginning of the autoclaves which are now essential in every bacteriological laboratory, and of the huge sterilizers without which no hospital in the world—scarcely even a field hospital—is considered to be properly equipped.



There were many other details of interest to specialists, such as the precautions required in decanting from one vessel to another, the free use of cotton wool as a germ filter, or the "glass garden," which was a special device for observing under the microscope the growth of an organism from hour to hour, or day to day. They must be passed over here; but we may briefly refer to the sterilizing of milk, as a further illustration of Lister's method of meeting the difficulties that were encountered by the early workers in the field of bacteriology.

Milk is the most difficult of all animal fluids to deal with. Supplying nutriment in a form which is acceptable to nearly every germ that infests air and water, it can scarcely be

obtained uncontaminated by milking the healthiest cow *al fresco* into a sterilized vessel with the strictest antiseptic precautions. The feat has been accomplished, but it is not easy; and therefore, for experimental purposes, milk must be sterilized by heat. Prolonged boiling over a spirit lamp is often ineffectual, and thus milk was the last hope of the believers in spontaneous generation, and the nightmare of the upholders of the "germ theory."

The trouble is due to two causes: first, because frothing occurs when milk is heated over the flame; and the vapour that escapes in the bubbles, before boiling is complete, wafts the germs with which all but the freshest milk teems, to imperfectly heated parts of the containing vessel; secondly, because prolonged heating is required, owing, as Lister thought, to the fact that "it is a heterogeneous fluid containing oily particles in suspension, which tend as time passes to aggregate and coalesce." [1] Herded together in these droplets of butter, the organisms are protected from the action of the hot watery fluid. They are thus practically exposed only to a dry heat, which is much less destructive than a moist heat to these low forms of life. Moreover, Lister always thought that "large numbers of bacteria grouped in masses were more resistant to heat than segregated bacteria."

The frothing was easily overcome by weighting the vessel containing the milk with a ballast of shot and plunging it in a water bath; for it was found that, although it was impossible to raise the temperature of the milk in this way above 210° F., this was usually enough if it was maintained for a long period. And yet, in spite of more rigorous precautions than were required for most fluids, a sample of milk occasionally "went wrong."

Lister had been in the habit of pouring the milk down a funnel long enough to reach to the bottom of the previously superheated flasks in which it was to be boiled. This involved a certain amount of bubbling, and he guessed that these bubbles caused the mischief in the same way as the bubbles had done in the early stages of boiling over a spirit lamp. Instead, therefore, of pouring the milk down a

[1] *Collected Papers*, vol. i. p. 358, note 2.

funnel, he now introduced it very gradually by means of a syphon, which reached to the bottom of the flask; and from this time forward bubbling was absolutely avoided, and this refractory fluid was as easy to manage as any other.

The six papers dealing with bacteriological subjects are placed together at the end of the first volume of the *Collected Papers*. They appeared between the years 1873 and 1881. For the present we are only concerned with the first two.

The first of these was delivered orally to the Royal Society of Edinburgh in 1873,[1] but was corrected and enlarged for publication in 1875. It was prompted by a remarkable paper by Dr. Burdon Sanderson,[2] which appeared to show:

1. That bacteria are conveyed by water but not by air.
2. That air carries fungi but not bacteria.
3. That bacteria are killed by simply drying them at a temperature of 100° F.[3]

These were indeed new and startling propositions, for, as Lister said:

"Now, if these conclusions were strictly correct, they would affect my surgical practice in a most important manner. If it were true that the air does not contain the causes of putrefaction, then it would not be necessary for me, in carrying out the antiseptic system of treatment, to provide an antiseptic atmosphere. All that would be needful would be to purify the surface of the skin of the part to be operated upon by means of some efficient antiseptic, to have my own hands, and those of my assistants, and also the instruments, similarly purified; and then the operation might be performed without the antiseptic spray[4] which we now use, and no one would rejoice more than myself to be able to dispense with it.

At the same time, striking as Dr. Sanderson's facts were, I could not believe the truth to be exactly as he stated—that 'no amount

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[1] "A Contribution to the Germ Theory of Putrefaction and other Fermentative Changes, and to the Natural History of Torulae and Bacteria," *Trans. Roy. Soc. Edin.* 1875, vol. xxvii. p. 313. *Collected Papers*, vol. i. p. 275.

[2] Afterwards Sir John Burdon Sanderson.

[3] *Quart. Journ. Micros. Sci.*, 1871, n.s. vol. xi. p. 323.

[4] The "Spray," by means of which it was intended to produce an antiseptic atmosphere, is described in the next chapter.

of exposure has any effect in determining the evolution of microzymes' (bacteria).[1] Various considerations, including circumstances that I had witnessed in surgical practice, made me fear the news was too good to be true. I determined, therefore, to put the matter to the test by a very simple experiment."

It was easy to show that his doubts were well founded, and that, at all events, the dust in the air of his study did actually convey bacteria to unboiled urine, which is a much better medium for bacterial growth than Pasteur's solution, with which Burdon Sanderson had worked. Having satisfied himself about the air inside the house, he next took a sterilized wine-glass out into the street, in December, 1871, during a drizzling rain which had been falling all the afternoon, and, raising the cover, allowed a few drops of rain to fall into the glass, and, having covered it again and brought it back into the house, then poured into it some unboiled urine.

The crop derived from this aerial sowing contained bacteria; so the primary object of the research was obtained. But it included also a torula (yeast) and a filamentous fungus, the study of which started him on a new line of enquiry, in which an attempt was made to throw light upon the functions of bacteria and their position in the vegetable kingdom.

The torula differed in many ways from ordinary brewer's or baker's yeast (*Torula cerevisiae*). Its life history, together with that of the other organisms present, was studied by cultivating them in various media, and modifying the circumstances in other ways. At last Lister satisfied himself that, on the one hand, the filamentous fungus could develop into the torula, and on the other, that it could form bacteria, which were indistinguishable in appearance from those which appeared free in the cultivating fluid.

With these misleading conclusions in his mind, he placed a minute speck of German yeast in a glass of cultivating medium, hoping to be able to grow a fungus form of Torula cerevisiae. A fungus made its appearance in due course, but it turned out that this fungus had nothing to do with Torula cerevisiae. It afforded, however, interesting material for further study, which was described in considerable detail.

[1] See *Quart. Journ. Micros. Sci.*, 1871, n.s. vol. xi. p. 338.

As neither the rain drops nor the morsel of yeast contained only one species of organism, it is not surprising that some of the deductions, notably those which referred to the origin of bacteria, did not stand the test of time. Others, however, were of great and permanent value. Amongst the most important are the following:

1. That variations of form and fermentative energy of micro-organisms may occur under the modifying influence of different media, and that such modifications may be produced or counteracted at will by transferring the organism from one medium to another:

2. That the products of the fermentation of an albuminous liquid may be inodorous, or at least devoid of the smell usually associated with putrefaction.

Both of these facts had a bearing on practical surgery. The absence of a putrefactive smell could no longer be taken as a proof of the absence of septicity; and the fact that no obvious smell was associated with such diseases as erysipelas did not prove, as had been supposed, that they were not caused by septic germs. This advance of thought, from thinking of putrefaction to thinking of infection, was of the utmost importance. The deduction which he made with regard to hospital gangrene is an instructive illustration of the direction in which his thoughts were tending. He had noticed that this disease was specially apt to occur where dressings were left for a long time unchanged, whereas, in the same hospital ward, sores dressed daily continued healthy. On this his comment was as follows: "Assuming what analogy leads us to suspect, that some organism is the cause of the disease, why should the special virus of hospital gangrene become introduced into a sore under the former condition more than under the latter? We now see that it is not essential to assume the existence of a special virus at all, but that organisms common to all the sores in the ward may, for aught we know, assume specific properties in the discharges long putrefying under the dressings. Similarly, we can imagine the unhealthiness of an old uncleansed hospital as caused not by the introduction into it of new organisms, but by a modification of those common to it and to freshly

built institutions. I take these illustrations from surgery; but to the medical reader others of equal importance will readily suggest themselves from physic." [1]

The suggestion is ingenious, but fortunately it is hardly supported by subsequent discoveries. We believe now that circumstances may modify the severity, and perhaps, though this is more doubtful, the complications of an epidemic by influencing the fermentative energy of the specific organism that causes it; but we think we know that the specific characters of these micro-organisms are constant, and that a harmless saprophyte cannot be converted by any change of circumstances into the bacillus of cholera or the undiscovered germ of scarlet fever; and yet, after all, Lister may have been right. Strange facts have recently come to light. One observer claims that he can change at will the hay bacillus into bacillus anthracis, and as easily reverse the process; and the doubtful relationship of the different strains of tubercle bacilli is enough to remind us that this great question is not yet settled.

The words quoted above are found in the second of the two earlier bacteriological papers, which, though delivered after the first, was published before it. In this communication his views regarding the relationship of some hyphomycetous fungi to torulae and bacteria are restated, and, in accordance with this supposed mode of origin of bacteria, it was said that "such organisms, like the fungi from which they are derived, are of various totally distinct kinds, manifesting their differences both morphologically and still more physiologically by the characters of the fermentative changes to which they give rise, and by the circumstance that some sorts refuse to grow at all in media in which others thrive." According to this view all previous classifications of bacteria based upon absolute morphological characters would have to be superseded or supplemented by one based upon their physiological characters. "And even these," he added, "appear by no means constant; for we shall in the present paper see reason to believe that one and the same bacterium may differ at different times

[1] *Collected Papers*, vol. i. p. 333.

in its fermentative effects on one and the same organic solution." [1]

The object of the second research was to throw light on this question by tracing the life history of particular organisms under the varied conditions he was now in a position to impose upon them.

The first crop to be investigated was obtained by exposing in his study a glass of milk which had remained free from growth from April to June. In due time a delicate filamentous fungus and two varieties of bacteria made their appearance. One of the bacteria produced an extraordinary viscosity in the milk, so that, as he said, he amused himself by spinning long webs with it from one object to another. The other bacterium, which appeared to cause a bright yellow colour in the milk, he thought was derived from the filamentous fungus.

He next tried to isolate and study the life history of the ferment that causes the lactic acid fermentation. A glass of sterilized milk, after having been inoculated with a drop of sour milk, curdled in thirty hours, and showed under the microscope innumerable motionless bacteria such as were known to be always seen in sour milk. Drops of the same sour milk were also introduced into turnip infusion and urine. In both fluids bacteria developed, the appearance, growth and fermentative characters of which are very carefully described. Two only of these observations need be mentioned. 1st. That after growing the organism, or—shall we say organisms, in urine, and afterwards in Pasteur's [illegible] and then again in urine, a drop of the last culture into milk caused lactic acid fermentation [illegible] three days. 2nd. That, in this soured [illegible] strange black mass appeared, which in [illegible] and then stopped growing. The [illegible] substance is discussed at great [illegible] bility of its being caused by [illegible] of the "pigment bacteria" [illegible] sidered, Lister rejected [illegible] probably caused by [illegible]

recognised as the lactic acid ferment, whose physiological functions he thought had been modified by the various transplantations to which it had been subjected.

To compensate for the brevity of this imperfect summary of a closely reasoned paper, the conclusions arrived at shall be given in full.

"Admitting then that we had here to deal with only one bacterium, it presents such peculiarities both morphologically and physiologically as to justify us, I think, in regarding it as a definite and recognisable species for which I venture to suggest the name *Bacterium lactis*. This I do with diffidence, believing that up to this time no bacterium has been defined by reliable characters. Whether this is the only bacterium that can occasion the lactic-acid fermentation, I am not prepared to say; but it seems most unlikely that any other kind will be found combining all the peculiarities of that which we have studied. What fungus it is derived from, if, indeed, it have come from any (for it would be rash to assume that such an origin is universal), I have no means at present of knowing; but, however that may be, it cannot but be right, where we have definite characters of bacteria, to speak of them as species as a matter of convenience, just as is done of various hyphomycetous fungi known to be only inferior varieties of ascomycetous forms.

What are the functions of bacteria with reference to the physiology of fungi, and whether a bacterium derived from a fungus is ever capable of returning to the form of its parent, are questions on which my investigation has thrown no light."[1]

The appreciation and criticism of this earlier bacteriological work cannot be better expressed than in the words of Pasteur himself. Lister himself.

took the opportunity of having worked at a subject had done so much to elucidate, to open up a ation with the French savant in the following ed Pasteur so much that he quoted it in ntation of beer, published in 1876.

"Édimbourg, 10 février 1874.

de vous offrir une brochure que qui rend compte de quelques ntouré de tant de lumière : on. J'aime à croire que ore j'ai écrit sur un

organisme que vous avez le premier étudié dans votre *Mémoire sur la fermentation appelée lactique.*

J'ignore si les annales de la chirurgie britannique ont jamais passé sous vos yeux. Dans le cas où vous les auriez lues, vous avez dû y trouver, de temps à autre, des nouvelles du système antiseptique que, depuis ces neuf dernières années, je tâche d'amener à la perfection.

Permettez-moi de saisir cette occasion de vous adresser mes plus cordiaux remercîments pour m'avoir, par vos brillantes recherches, démontré la vérité de la théorie des germes de putréfaction et m'avoir ainsi donné le seul principe qui pût mener à bonne fin le système antiseptique.

Si jamais vous veniez à Édimbourg ce serait, je crois, une vraie récompense pour vous, que de voir à notre hôpital dans quelle large mesure le genre humain a profité de vos travaux. Ai-je besoin d'ajouter quelle grande satisfaction j'éprouverais à vous montrer ici ce dont la Chirurgie vous est redevable.

Excusez la franchise qui m'est inspirée par notre commun amour de la Science et croyez au profond respect de votre trés-sincère

JOSEPH LISTER." [1]

This was the beginning of an acquaintance which ripened into friendship. Pasteur at once fixed upon the weak point in the chain of evidence, to which reference has been made, and sent the following characteristic and graceful reply:

CHER MONSIEUR, " PARIS, le 27 Fév. 1874.

J'ai beaucoup tardé de répondre à votre très excellente lettre du 10 février courant. Ce n'est certes point par indifférence. Bien au contraire. Votre lettre m'a procuré la plus vive satisfaction et tout de suite j'ai prié un de mes bons amis qui connaît bien l'Anglais de me traduire la brochure que vous aviez eu l'obligeance de joindre à votre envoi. J'avais bien entendu parler de votre système antiseptique, par cet ami même, dont je parle, qui est médecin en chef au Val de Grâce, et des grands succès de votre pratique chirurgicale, par Tyndall, mais j'avoue à ma honte que j'étais et que je suis encore très peu édifié sur vos travaux, tout en ayant depuis longtemps le vif désir de les connaître. Votre brochure et l'analyse que m'en a fait mon ami ajoutent à mon impatience et à mes regrets. Je suis extrêmement surpris de la précision de vos manipulations, de votre entente parfaite de la méthode expérimentale, et c'est pour moi une énigme que vous puissiez vous livrer à des recherches qui exigent tant de soins, de temps, de labeurs de tous les instants, tout en vous livrant à la profession de chirurgien et de chef d'un grand établisse-

[1] *Études sur la bi[illegible]* par L. Pasteur. Gauthier-Villars, Paris, 1876, p. 43.

ment hospitalier. Je ne crois pas que chez nous on trouverait un autre exemple de ce prodige.

Avec mon illustre maître et ami, M. Dumas, secrétaire perpétuel de notre Académie des Sciences, j'ai causé de vous et de votre lettre que je lui ai communiquée. M. Dumas m'a exprimé le désir et je joins ma prière à la sienne que vous prissiez la peine de lui envoyer, pour être communiquée à l'Académie, une notice un peu détaillée sur votre système antiseptique et sur vos pratiques. J'ai eu l'occasion de placer la conversation avec divers chirurgiens de grand talent sur vos méthodes ; ils les connaissent sans doute et quelques-uns même les appliquent, mais je crois qu'ils n'ont qu'une connaissance incomplète à ce sujet et vous rendriez service à la chirurgie française et à vos amis en cédant au désir de M. Dumas.

Quant à moi, je serais, en outre, très heureux que vous voulussiez bien m'envoyer si vous le pouvez, quand vous en aurez le loisir, quelques exemplaires séparés de vos principaux travaux scientifiques, par exemple, de ceux aux quels vous renvoyez dans le mémoire que vous m'avez adressé.

Pour ce qui est du fond même de ce dernier travail, sans avoir le droit de contester la légitimité de vos conclusions, si j'en avais le loisir je prendrais la liberté de vous présenter quelques observations critiques. Je vais vous donner une idée des doutes que j'éléverais si j'avais le bonheur de pouvoir converser avec vous et me laisser aller à mes impressions : prenez du vin auquel vous ajouterez un peu de vinaigre. Déposez ensuite à la surface du liquide et simultanément du *mycoderma vini* et du *mycoderma aceti*. Le M. aceti se développera seul. Répétez cet essai sur du vin jeune non additionné de vinaigre ; c'est le M. vini qui se développera seul. Bien plus, en semant sur ce vin du M. vini, il arrivera souvent que le M. aceti *spontané*, c'est à dire apporté à l'état de germe par l'air, se développera seul après quelques temps. Inversement sur le vin jeune, sans addition de vinaigre, semez du M. aceti et c'est le M. vini spontané que vous récolterez. Ne trouvez-vous pas dans ces faits, dont j'atteste l'exactitude, de quoi jeter du doute sur certaines de vos conclusions ? Supposez que j'étais dans l'ignorance absolue de la nature de mes semences, comme vous l'êtes vous-même pour les vôtres, n'aurais-je pas le droit de dire : le Myc. vini se transforme en Myc. aceti et inversement ? Pourtant il n'en est rien. Votre méthode de culture est remarquable de rigueur et d'entente des difficultés de ce genre d'études, mais j'ose vous dire que je la voudrais plus rigueureuse encore et être plus sûr de la pureté de vos semences.

Je voudrais poursuivre, mais l'écriture me fatigue promptement. Au moi d'Octobre 1868, j'ai été frappé de paralysie du côté gauche et je ne suis qu'à moitié guéri de cette terrible secousse. Ma tête ne peut supporter, à un moment donné, qu'une dose limitée d'effort

et de travail. L'inclination de la tête partout pendant que j'écris m'est très pénible. Mais c'est à regret que je vous quitte.

Veuillez agréer, cher monsieur, la nouvelle expression de mes remerciements pour votre aimable et bienveillante communication et recevoir l'assurance de mes sentiments de haute estime et de dévoûement.

L. PASTEUR." [1]

[1] DEAR SIR,

I have long delayed answering your very excellent letter of the 10th February. This is certainly not from indifference. Quite the contrary. Your letter gave me the liveliest satisfaction, and I immediately asked one of my good friends who knows English well to translate for me the pamphlet which you had been good enough to send with it. I had indeed heard of your antiseptic system from the friend of whom I speak, who is the chief surgeon at the Val de Grâce, and of the great success of your surgical practice from Tyndall, but I confess to my shame that I was and am still very little acquainted with your work, although for a long time keenly desirous to know about it. Your pamphlet and the analysis of it which my friend has made for me add to my impatience and to my regret. I am extremely surprised at the precision of your manipulations, at your perfect comprehension of the experimental method, and it is an enigma to me that you can devote yourself to researches which demand so much care, time and incessant painstaking, at the same time as you devote yourself to the profession of surgery and to that of chief surgeon to a great hospital. I do not think that another instance of such a prodigy could be found amongst us here.

I have spoken to my illustrious master and friend, M. Dumas, the permanent secretary of our Académie des Sciences, about you and your letter which I have shown him. M. Dumas expressed to me his desire, and I add my own request to his, that you would have the kindness to send him a somewhat detailed account of your antiseptic system and your practice for communication to the Académie. I have had the opportunity of speaking about your methods with some very able surgeons; they are certainly acquainted with them and a few even make use of them, but I think that they have only an incomplete knowledge of this subject, and you would be doing a service to French surgery and to your friends by acceding to the wish of M. Dumas.

For my own part, I should also be much obliged if you would kindly send me, if you can, when you have the time, a few separate copies of your principal scientific works, for example, those to which you refer in the pamphlet you have sent me.

As regards that which is the very foundation of this last work, though I have no right to contest the legitimacy of your conclusions, if I had the time I would make free to offer a few critical observations. I am going to give you an idea of the doubts which I should raise if I had the pleasure of being able to have a talk with you and give free expression to my thoughts: take some wine and add to it a little vinegar. Then place on the surface of the liquid and at the same time some *mycoderma vini* and some *mycoderma aceti*. Only the M. aceti will develop. Repeat this experiment with some new wine without the addition of vinegar; it is only the M. vini which will develop. Further, if you sow M. vini on this wine, it will often happen that only M. aceti will develop, after a certain length of time, *spontaneously*, that is, it will have been brought there by the air in the

It is not known whether Lister answered this letter, but that he accepted Pasteur's criticism as well founded is shown by his own recantation in a later paper on the lactic acid fermentation: "And now, before proceeding further, I desire to correct a mistake into which I fell when investigating this same fermentation some years ago; for next to the promulgation of new truth, the best thing, I conceive, that a man can do, is the recantation of a published error." After recapitulating his former observations, he adds: "Here then were the facts all wrong. What was the explanation? I had obviously got some accidental contamination of the *Bacterium lactis* with other forms, although in doing the inoculations I had only introduced a very minute portion with the point of a heated needle." [1]

Lister's later and more important bacteriological work will be taken in its proper place. These early studies are introduced here because they were the diversions, if they may be so called, of his busy life in Edinburgh. But they were dovetailed in with other experimental enquiries of a more practical nature, which are described in the next chapter. If Pasteur had known of these he would have found it a still more puzzling enigma that opportunity could be found to carry out researches "qui exigent tant de soins, de temps, de labeurs de tous les instants."

form of a germ. Conversely, sow M. aceti on the new wine to which no vinegar has been added, and you will gather a crop of M. vini developed spontaneously. Do not you see in these facts, the accuracy of which I can vouch for, something which casts a doubt on some of your conclusions? Suppose that I was absolutely ignorant of the nature of what I was sowing, as you yourself are of yours, should not I be justified in saying that the Myc. vini changes itself into the Myc. aceti and vice versa? And yet it is nothing of the sort. Your method of culture is remarkable for its exactitude and for the appreciation it shows of the difficulties of this class of studies, but I venture to tell you that I could wish it were more rigorous still, and to be more sure about the purity of your sowings.

I should like to go on, but writing quickly fatigues me. In the month of October, 1868, I was struck with paralysis of the left side, and I have only half recovered from this terrible shock. My head can only stand, at one time, a limited dose of effort and work. Bending my head especially when I write is very painful to me. But I leave you with regret.

Please accept, my dear sir, a further expression of my thanks for your kind and friendly letter, and receive the assurance of my feeling of great esteem and devotion. L. PASTEUR.

[1] *Collected Papers*, vol. i. pp. 366, 368.

CHAPTER XIX

THE SPRAY. GAUZE DRESSINGS. DRAINAGE

Two important modifications of the antiseptic treatment were introduced during the early part of Lister's second Edinburgh period. One of these involved a question of principle which tried the faith of his followers, and a practice which caused them much physical discomfort. This was his attempt to render the air innocuous by means of an antiseptic spray. The other innovation was the substitution of an absorbent gauze dressing for the non-absorbing lac plaister. Though not of equal importance it will be convenient to consider these two matters together, because, from this time forward, the term "carbolic-acid treatment" was superseded by that of "spray-and-gauze treatment" in the language of those who could not grasp the antiseptic principle, but, by fixing on two unessential details, held the whole thing up to ridicule.

In order to understand why the spray was introduced it must be borne in mind that Pasteur's teaching strongly corroborated the time-hallowed belief that the air was the principal agent by which wounds were contaminated; and that at this time little had been done in the way of differentiating one kind of bacterium from another, much less in distinguishing those which were afterwards called pathogenic, that is disease-producing, from those which are harmless.

The perils of the air were further accentuated by the ingenious experiments of John Tyndall, who now entered the lists. Tyndall was a physicist—perhaps the best known of his day to the British public. A first-rate experimenter and a sound reasoner, he wrote and spoke with a graphic and impressive but simple eloquence that was all his own.

He was not a recluse whose work is buried from the public gaze in the dusty volumes of the *Philosophical Transactions*. He was equally at home at the Royal Society and at the Royal Institution; appealing to a jury of scientific experts, or instructing a critical popular audience. He thus probably did as much as any man of his time to familiarize his fellow-citizens with the bearing of the "germ theory" and the question of "spontaneous generation" upon the treatment of wounds and the study of infectious diseases.

His collected essays on "the floating matter in the air" were published in 1881, but the first of them, "Dust and Disease," tells of researches begun as early as 1869. They are as readable to-day as they were thirty-five years ago. They range over a very wide field, trenching on those of the pathologist, the physician and the surgeon. He was indeed on this account freely criticized. The *Lancet* was furious, and even Lister said in a letter to his brother, "It is almost a pity that Tyndall should have meddled with things beyond his beat." It was thought that he was quitting his métier in speaking of such things as the germ theory and spontaneous generation. To quote his own words:

"My own interference with this great question, while sanctioned by many eminent names, has been also an object of varied and ingenious attack. On this point I will only say that when angry feeling escapes from behind the intellect, where it may be useful as an urging force, and places itself athwart the intellect, it is liable to produce all manner of delusions. Thus my censors, for the most part, have levelled their remarks against positions which were never assumed, and against claims which were never made." [1]

He was well able to defend himself and support his right to take part in this great controversy:

"I am dealing," he said, "with a question on which minds accustomed to weigh the value of experimental evidence are alone competent to decide, and regarding which, in its present condition, minds so trained are as capable of forming an opinion as regarding the phenomena of magnetism or radiant heat. 'The germ theory of disease,' it has been said, 'appertains to the biologist and the

[1] *Essays on the Floating-matter in the Air in Relation to Putrefaction and Infection*, by John Tyndall, F.R.S. London, Longmans, Green & Co., 1881, p. 27.

physician.' Where, I would ask in reply, is the biologist or physician, whose researches, in connection with this subject, could for one instant be compared to those of the chemist Pasteur? It is not the philosophic members of the medical profession who are dull to the reception of truth not originated within the pale of the profession itself." [1]

Tyndall's main new contribution to the question consisted in demonstrating not only the existence, but the amount, of floating matter in the air, in such a simple way that it could easily be recognized by the untrained naked eye of an amateur. This was done by passing through any particular sample of air a concentrated ray of light, which thereupon became illuminated to a varying extent, in accordance with the amount of floating dust present. He then showed that, if this dust were allowed to settle, say in a glass flask, the transmitted beam was no longer illuminated. The contents were "black empty stellar space." Another experiment proved that, by appropriate means, such as the introduction of an incandescent wire, all the dust in such a flask was drawn into the vortex by the currents produced, and burnt up in a few minutes. On the other hand, the dust was not destroyed by allowing the air to bubble through strong acids and alkalis. But the crowning point was the demonstration, by countless experiments, that sterilized putrescible solutions—infusions of all imaginable things, from hay and turnip to tripe and oysters—might be freely exposed to optically pure air, that is air deprived of its visible dust, no matter how the optical purity had been obtained, without undergoing decomposition; but that, if these solutions were subsequently exposed in the optically impure air of the laboratory in which the experiments were being conducted, they promptly and invariably grew moulds and bacteria in abundance.

These were very satisfying and convincing experiments, and they represent only a part of those which Tyndall carried out; for he undertook many others to confirm or disprove those of Pasteur, Roberts, Burdon Sanderson, Bastian and others. But they did not, after all, carry the matter appreciably further. They had one excellent effect: they answered the cavils of

[1] *Loc. cit.* p. 42.

the believers in the everyday occurrence of spontaneous generation, who kept saying, "Show us your germs"; but, on the other hand, they had a mischievous influence in so far as they tended to concentrate the attention of surgeons upon the air as the prime source of septic infection.

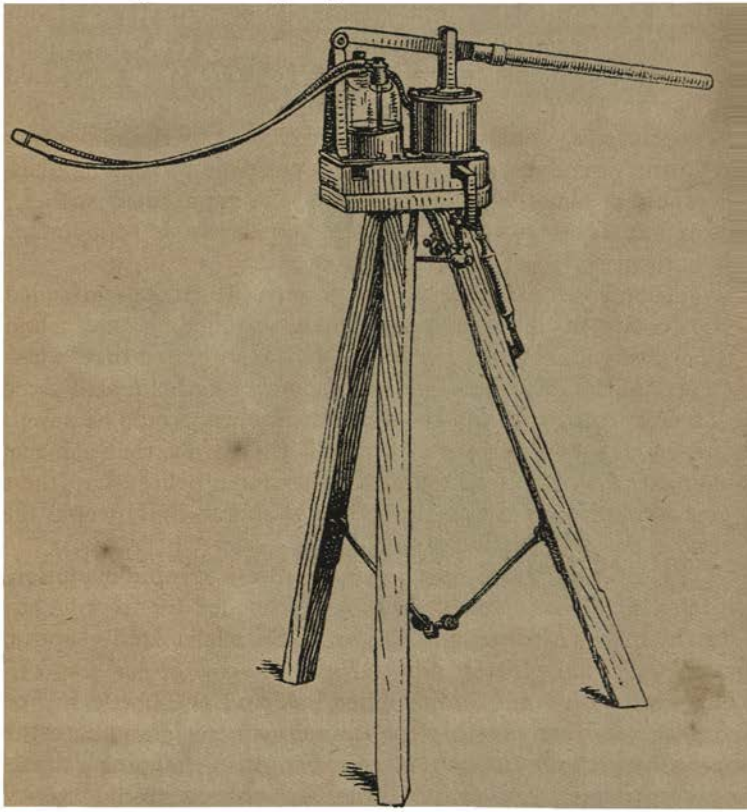
Lister himself was so convinced of the important part played by the air in this respect that he thought and said that the mere removal of a drainage tube, without antiseptic precautions, would be likely to be followed by decomposition in the wound, because the air that passed in to take its place would be almost certain to carry in some germs along with it; and at this stage of his work most germs were, in his opinion, pathogenic.

That is why the spray was introduced. It was intended to create an antiseptic atmosphere, surrounding the wound far and wide in all directions. It was supposed that, wherever the spray penetrated, the vapour of carbolic acid given off from the drops, and the drops themselves, would be powerful enough to destroy instantly all the germs that came in contact with it, in spite of the common belief that these germs were at least as numerous as motes that people the sunbeam.

The spray-producer underwent a process of rapid evolution. First a small hand spray, originally intended for freezing the skin by means of ether, and known as Dr. Richardson's[1] spray, was used; and Lister pointed out, in one of his papers,[2] that, by holding the indiarubber ball and the bottle in one hand, it was just possible for the surgeon to manipulate the apparatus without the help of an assistant in changing a dressing. But this feat required an amount of ambidexterity not easy to attain. To get over the difficulty a foot spray was introduced, in which the bellows was worked by the foot, leaving both hands, if not the co-ordinating faculty, unoccupied. But both the hand and the foot spray involved so much physical exhaustion that they could only be used for an operation of even moderate length by providing a relay of assistants. The next model stood upon a tripod, and was worked with ease by a long handle. It was a cumbrous

[1] *Collected Papers*, vol. ii. p. 166. [2] *Collected Papers*, vol. ii. p. 181.

affair, which, as it could not be concealed from view in the brougham during its passage from house to house, became the object of mild chaff, and the possessor of an unflattering nickname—"the donkey engine."

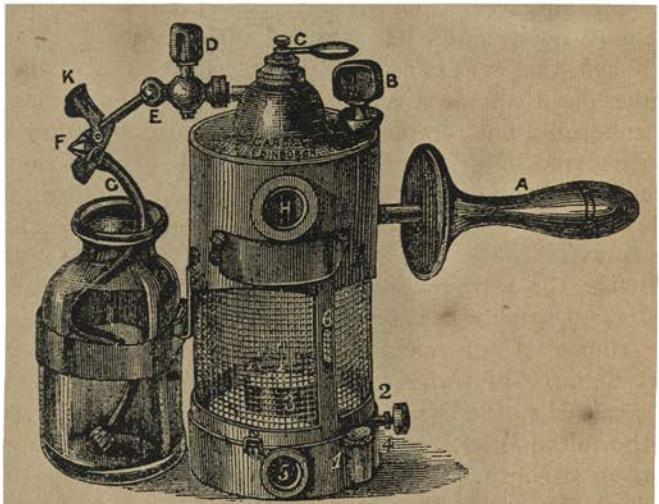


THE "DONKEY ENGINE."

Before long this gave place to the "steam spray," a real beautifully designed machine, the details of which need n be described, but may be gathered from the figure on the ne page. There were two sizes, one for prolonged operation the other smaller for use during short operations, or t changing of dressings. With the former a huge cloud fine spray could be produced, enveloping the patient a

all those engaged in the operation, and capable of filling a room of moderate dimensions from floor to ceiling with a more or less dense, damp and pungent mist.

It is needless to say that, though the spray gave a great sense of security, it was recognized by all, and by no one more than Lister himself, as an evil—"a necessary evil, incurred to attain a greater good." [1] He held it to be the least necessary of all his precautions, however, and would have been glad to



THE "STEAM SPRAY."

do without it. Sometimes it would not work; occasionally it broke down in the middle of an operation, which was the source of much anxiety if the case was a serious one. Sometimes the vapour was too coarse—"a wetting spray"—and then the hands of the operator as well as the wound were deluged with the lotion; and, although this was supposed to be never stronger than one part of carbolic acid to forty of water, the fingers became white and numb, and it was altogether a rather trying ordeal. In any case the carbolized steam passed into the lungs, and when operations were performed in a room illuminated by gas or lamps which decomposed the chloroform

[1] *Collected Papers*, vol. ii. p. 181.

vapour, setting free that acrid product, chlorine gas, the occasion often became a trial rather of physical endurance than of nervous stability. There are, moreover, some healthy people on whom carbolic acid acts in a most unpleasant way, and others who are not healthy to whom it is positively deleterious. Both these classes were, as it happened, represented amongst Lister's loyal followers, and they were practically debarred from using the spray. At the time, it appeared strange that they nevertheless continued to obtain good results. It now seems more strange that their success did not cast more doubt upon its efficiency or necessity.

Though the evil effect upon the surgeons was obvious, another disadvantage was almost overlooked: the unconscious patients could not complain, but it is certain that they must have suffered in an equal degree, and many cases of so-called carbolic-acid poisoning, that is of sickness and carboluria following operations, were no doubt largely due to inhaling the spray.

Before the introduction of the spray it had been Lister's custom to irrigate the wound more or less constantly, during the course of an operation, with carbolic-acid lotion, one part to forty of water. He was well aware of the damage thus caused to the living tissues, and of the resulting increase of the initial discharge. He therefore reduced it more and more in strength. At the Plymouth meeting of the British Medical Association in 1871, at which he first publicly recommended the spray, he advised that it should be used as weak as one part of carbolic acid to one hundred of water. This advice he subsequently withdrew, and returned to the original strength of one part to forty. At the end of the operation, after the stitches had been introduced, it had been the custom to distend the wound with the lotion by means of a syringe. This, like the irrigation, was now dispensed with. And thus, though the spray was actually an irrigator, there is no doubt that when it worked properly the amount of carbolic acid applied to the wound was much less than before its introduction.

The spray was used all over the world for many years. Doubts were raised from time to time as to its utility, which

culminated in a remarkable paper by Bruns of Tübingen in 1880, with the arresting title, "Fort mit dem Spray!" in which he suggested a return to irrigation.[1] After this, many surgeons abandoned its use, but Lister, though he spoke hesitatingly about it at the International Medical Congress in 1881, continued to employ it till 1887. Let us now enquire into the reasons for its relinquishment.

Amongst the notable surgical advances of the last half of the nineteenth century none was more striking than the conversion of ovariotomy from one of the most dangerous into one of the safest of surgical procedures. The two pioneer workers in this field were Spencer Wells and Thomas Keith. The success of both was largely due to the attention they devoted to cleanliness, and as Lister said, they had "achieved results which astonished the world before strict antiseptic treatment was thought of."[2]

Spencer Wells had read Pasteur's writings and accepted the germ theory of disease; indeed it almost seems as if he had grasped the antiseptic principle[3] before Lister, though he did not follow up the clue.

Thomas Keith had at this time obtained probably greater success with ovariotomy than any living surgeon, which must be attributed partly to his manual dexterity, but chiefly to his extraordinary attention to all manner of details, especially to that of cleanliness. He was a remarkable man, with something of the irritable temperament that often accompanies indifferent health, but intensely devoted to his work, and almost morbidly anxious about the welfare of each individual patient. Sometimes bitter words spoken without due thought made those who did not know him well, misjudge his character, but, as Lister said truly in 1869, "He has the earnest loving spirit of a real surgeon." There was a close intimacy between them in Edinburgh, and, whatever may be said to the contrary, it is a fact that their friendship continued during the rest of Keith's life.

[1] *Berl. klin. Woch.* 1880, xvii. p. 609. [2] *Collected Papers*, vol. ii. p. 275.

[3] "Some Causes of Excessive Mortality after Surgical Operations." By T. Spencer Wells. An address at the annual meeting of the British Medical Association at Cambridge, 1864. *Brit. Med. Journ.* 1864, vol. ii. p. 384.

It must have been a heart-searching question for one who had so far outstepped his fellows as to have reduced his mortality after ovariotomy to 16 per cent. in 1870[1]—that is less than half the then average mortality—whether he should adopt so fundamental a modification of his *modus operandi* as the rigid antiseptic treatment according to Lister involved. Lister at first dissuaded him from doing so, because he recognized that the peritoneal cavity was already provided by nature with special protections against the attacks of micro-organisms, owing to its anatomical peculiarities as regards shape and size and its remarkable physiological function of rapidly absorbing effusions. He also thought that this most important physiological function might be interfered with by the irritating influence of carbolic acid in the lotions and the spray, and as he had not at this time complete confidence in the efficacy of the spray to exclude living micro-organisms, he feared that its employment might do more harm than good. In the normal state fluid is constantly being poured out and absorbed by the peritoneum, and, as the two processes exactly balance one another, an appropriate condition of mere moisture is maintained. But if anything upsets the balance by increasing effusion or diminishing absorption, or both, fluid accumulates, and, if living germs are at the same time introduced into the abdominal cavity, the result is disastrous, because the fluid is putrescible. It was the decomposition of this fluid that accounted for the awful mortality after all abdominal operations, when performed by what we should now call the "dirty" surgeons of old days, who were accustomed to handle the parts roughly and introduce gross particles of septic matter into the peritoneum, not exactly accidentally, but in following the recognized routine practice of the day. The results which Keith obtained showed that by gentle and dexterous manipulation, and scrupulous attention to cleanliness, such for example as boiling the sponges, the risk could be reduced to a minimum. The effusion was so slight and so quickly absorbed that the germs had no time and no place for their development.

[1] *Lancet*, 1870, vol. ii. p. 249.

Lister did not doubt that many living germs entered the peritoneal cavity in the course of a prolonged operation in which no antiseptic precautions were taken. His belief on this point was absolute, and at the time he thought that almost all of them were morbific. As Keith's results were so good, he therefore felt sure that the peritoneum had special means of dealing with them, and he guessed that the more important of these were the power of rapidly absorbing effused fluids, and the high vitality of the peritoneum itself. He knew that the spray must increase effusion, diminish absorption and lower the vitality of the living tissues. This might be of little consequence if it were really efficient in killing the germs, but he did not trust it for so large an operation field; and he thought that germs which had run the gauntlet of the spray would be able to grow and propagate in the more or less copious effusion which its irritation must produce. He therefore advised Keith to abstain from using it for the present.

They talked the matter over again and again, with the result that Keith at last decided to take it up, and at once, in Lister's own words, "on at length adopting strict antiseptic measures with an improved spray, for a while surpassed himself by an unbroken series of eighty successful cases. Yet, wonderful as this achievement was, it was only a difference in degree from his former experience, and assuredly no absolute proof of superiority of the new means employed." [1] Keith afterwards abandoned the spray, partly, it is believed, because he thought its effect injurious to the patients, partly because it was certainly injurious in the highest degree to himself. He continued, however, to use the other antiseptic precautions, and to this he attributed the superiority of his later results.

As time went on, for we must now look some distance ahead, the question was discussed with bitterness, almost with ferocity, amongst the ovariotomists. Some, whilst disowning the antiseptic principle root and branch, apparently unconsciously adopted much of its practice; others adopted both principle and practice with the exception of the spray, and there were yet others who omitted no jot or tittle of Lister's methods. Meanwhile it was obvious to candid observers,

[1] *Collected Papers*, vol. ii. p. 276.

through all this strife of tongues, that, although the statistics of the antiseptic surgeons were on the whole the best, some at least of their opponents could show very excellent results indeed; and this provided a stumbling-block to many, though not to Lister. Nevertheless it gave him much matter for thought, and especially as regards the efficacy and importance of the spray.

He had long recognized and taught that the healthy living tissue exercised an inhibiting influence upon the growth of micro-organisms, and it was common knowledge that the vital powers of the different tissues and parts of the body are not uniform. Thus wounds of the face heal more readily than those of the extremities, and the tissues of an infant more kindly than those of an old person. He thought, as we have said, that the success of ovariotomy without rigid antiseptic treatment depended in part upon the undoubtedly high vitality of the peritoneum. But he saw that this vital energy of the peritoneum was only in degree greater than that of the other tissues, and that the less it was interfered with in any wounds, either mechanically or chemically, the less would be the chance of survival of stray germs that might gain access to them. He therefore began to wonder whether, if only slightly damaged, for example by the mere incision made by a very sharp knife, the living tissues of any wound might not be able to deal with a certain number of germs by their own efforts, in the same way as they were dealt with in the peritoneum in successful ovariotomies performed without antiseptic precautions.

Stress is laid upon the limitation of number, because he had shown, by a series of elaborate experiments,[1] that the chance of infecting a putrescible fluid, such as blood serum, depended upon the concentration or dilution of the poisonous dose. In other words, a drop of the poisonous culture diluted to such an extent as to contain only one or two germs did not cause putrefaction, while a drop containing many as certainly gave rise to it as did the introduction of a piece of particulate dirt. This seemed to account for the fact that the peritoneum appeared to be specially vulnerable in pre-antiseptic days,

[1] *Collected Papers*, vol. ii. pp. 278 and 342.

because the doses of poison introduced were then usually too large to be resisted. Putrefaction thus almost always occurred after abdominal operations; and it attracted special attention, because septic wounds of the peritoneum were generally fatal, whereas the majority of ordinary septic wounds ultimately healed.

In the early days Lister did not know in what way the vital energy of the tissues modified the growth of micro-organisms. But he was prepared to accept Metchnikoff's marvellous discovery of phagocytosis when it was announced in 1883.[1] Metchnikoff had observed and figured the actual contest between the invading micro-organisms and the phagocytes or defending living cells, which, if the defence is successful, leads to the devouring and digesting of the invaders by the defenders; if unsuccessful, to the destruction of the garrison. This discovery supplied an additional argument in favour of the diminution of the strength of the chemical antiseptics employed, and the discontinuance of irrigation either with syringes or by means of the spray. Yet another argument for this course was afforded by the gradually accumulating weight of evidence that the proportion of the harmful pathogenic to the harmless non-pathogenic organisms was not so great as had been at first supposed, and that certainly the pathogenic organisms were not very plentiful in the air. In fact, it was becoming more and more evident that the air was, after all, not the principal source of wound infection—not nearly so great a source of danger as the patient's skin, the surgeon's hands, unsterilized sponges and instruments, and particulate dirt of all kinds.

It was not denied that the flora of the air existed in abundance, though perhaps not in such great abundance as Pasteur had suggested. Not every mote by any means carries its germ, though they are plentiful enough, as may be shown by exposing a plate of cultivating medium for a few minutes in one of our most elaborate "aseptic" operating theatres. But, fortunately, the product will consist in great part of harmless moulds, or yeasts, quite incapable of causing putrefaction, and, if a solitary pathogenic organism is occasionally

[1] *Biol. Centralbl.* 1883, iii. p. 560.

found, it enters the wound so solitary, so unsupported, that it is almost sure to fall a prey to a healthy phagocyte.

Many of these important facts had not yet been discovered when, at the International Medical Congress in 1881, Lister said:

"Nevertheless I am aware that, concomitantly with the perfecting of the spray, there has been an improvement in other parts of our antiseptic arrangements, and I am not prepared to say that our increased uniformity of good results may not be due to the latter rather than to the former. And it may be, for aught I know, that when the International Medical Congress next meets I shall be able to speak of results of a still higher order obtained without using the spray at all. For if further investigation should confirm the conclusion to which our recent facts seem to point, and it should indeed be proved that all idea of atmospheric contamination of our wounds during operations may be thrown to the winds, then no one will say with more joy than myself, 'Fort mit dem Spray.'"[1]

In 1887 Lister finally abandoned the spray. His last word on lowering this standard, round which so many battles had been fought, has almost a touch of sadness, because he had to own that, after all—all the tumult of the captains and the shouting, all the misgivings and doubts that it had caused—the spray did not do and never could have done what he had claimed for it.

"As regards the spray," he said at the International Medical Congress in Berlin in 1890, "I feel ashamed that I should ever have recommended it for the purpose of destroying the microbes of the air. If we watch the formation of the spray and observe how its narrow initial cone expands as it advances, with fresh portions of air continually drawn into its vortex, we see that many of the microbes in it, having only just come under its influence, cannot possibly have been deprived of their vitality. Yet there was a time when I assumed that such was the case, and, trusting the spray implicitly as an atmosphere free from living organisms, omitted various precautions which I had before supposed to be essential. Thus, in opening the pleura in empyema for the purpose of evacuating the pus and introducing a drainage-tube and afterwards in changing the dressings, I had previously applied over the opening a piece of cloth steeped in an antiseptic lotion to act as a valve and prevent the entrance of air during inspiration. But under the spray I

[1] *Collected Papers*, vol. ii. p. 280.

omitted the valve and allowed the air to pass freely in and out of the pleural cavity, although I used the spray at such a distance from the producing apparatus that it was dry and transparent, with the particles of carbolic solution necessarily widely separated from each other. And these particles cannot have been in more than instantaneous contact with much of the dust before it was drawn within the chest, and securely protected by the pus or serum there from any further action of the antiseptic. It is physically impossible that the microbes in such dust can have been in any way whatever affected by their momentary presence in the spray." Further on in the same address he said, " Since we abandoned the spray, three years ago, we have been careful to compensate for its absence, not only by antiseptic washing and irrigation, but by surrounding the seat of operation with widespread towels wrung out of an antiseptic solution. For the spray, though useless for the object for which it was originally designed, had its value as a diffuse and perpetual irrigator, maintaining purity of the surgeon's hands and their vicinity as an unconscious caretaker. But if besides the spray we give up all washing and irrigation of the wound, our vigilance must be redoubled. Yet I believe that, with assistants duly impressed with the importance of their duties, the task would prove by no means difficult." [1]

These prophetic words fitly close the interesting and instructive story of the spray. They remind us, as may be needful, after what has been said in the way of depreciation, that the spray served a useful purpose, and probably, in the days of comparative ignorance, saved many lives. Though it did not kill all the microbes in the air, it did help to clear the mental atmosphere, and prepared the way for the simplification and consolidation of the antiseptic treatment.

The substitution of a gauze dressing for the lac plaister, though involving no radical change, was important, because it made the antiseptic treatment easier for the inexperienced to carry out, safer for adepts, and, on the whole, more comfortable for the patients.

Following the method of wound treatment adopted by most of his contemporaries, Lister had in the earliest antiseptic days employed a material capable of absorbing the discharge.

[1] *Brit. Med. Journ.* 1890, vol. ii. p. 378. *Collected Papers*, vol. ii. p. 336.

First he used lint soaked in carbolized oil, but he very soon gave up the absorbent dressings altogether, because, as he said in 1871 : " Hitherto I have been opposed to porous antiseptic dressings, having observed that when in the form of lint steeped in an oily solution of carbolic acid, the discharge, if at all free, washed out the antiseptic liquid from among the neutral fibres, and opened a way for the penetration of putrefaction." [1]

The putty and the various non-absorbent plaisters simply acted upon the discharges on their passage from the wound to the perilous outside world, where they were received into " cloths," of which the most that could be said was that they were " neutral," for it was not the custom to render them antiseptic, or even aseptic, except in so far as this end might have been attained by boiling them at the wash. The word " cloths " frequently occurs in Lister's writings. It has rather an antiquated ring, recalling the familiar phrase, " a fair linen cloth." It connoted towels or rag. At this time one of the most acceptable presents for a hospital was a bundle of old linen—a present that blessed the giver as well as the receiver. Many a poor man's poultice has been spread upon a rag marked with a coronet, or even with the Royal Crown. Rags were used not only for poultices, but for dressings, eking out the more expensive lint. It was into such rags, or into towels, that the discharge flowed from beneath the lac plaister, and there it usually remained until the dressing itself was changed.

Lister was led to modify his views with regard to absorbent dressings by hearing reports from various quarters of the efficacy of oakum as an antiseptic dressing. Oakum consists of old rope picked to pieces and treated with Stockholm tar (which contains creosote and other antiseptic hydrocarbons, but not, be it observed, carbolic acid). Each fibre of it is " imbued with an insoluble vehicle of the antiseptic," and thus, even if the discharge soaked through and through an oakum dressing, decomposition would not be able to spread

[1] " On a Case illustrating the Present Aspect of the Antiseptic System of Treatment in Surgery," *Brit. Med. Journ.* 1871, vol. i. p. 30. *Collected Papers*, vol. ii. p. 167.

along the moist track to the wound until all the antiseptic substances had been dissolved out of it and washed away.

He tried oakum first on superficial sores, interposing the "protective" to prevent irritation, and said that he found it to approach the ideal he had long had in view. It possessed the incidental advantage over an impermeable lac plaister that the skin remained dry under it, instead of becoming sodden with the accumulated perspiration and discharge; and partly for this reason, partly because putrefaction could not take place under any part of the dressing, the irritation often met with under the lac plaister seldom occurred.

But it was dirty and sticky, and redolent of the dockyard; pleasant enough as an occasional reminder of sea breezes, but wearisome for an invalid who could not escape from it, flavouring all his meals, and never allowing him to forget his malady.

So Lister set to work to apply what he called "the oakum principle," whilst eliminating these drawbacks; that is, to devise a porous dressing, every fibre of which should be charged with a material, neither sticky nor dirty, nor objectionably odoriferous, but capable of holding the carbolic acid firmly enough to withstand the dissolving effect of the discharges for a sufficient length of time, that is, at the least for twenty-four hours.

For this three things were necessary:

1. A convenient "vehicle" for the antiseptic.
2. A suitable fabric to hold it.
3. Even distribution of the vehicle amongst the fibres of the fabric.

It was by no means a simple proposition. For the vehicle he chose resin diluted with paraffin, which, it will be remembered, he had used in one of his early plaisters. For the fabric, a long hunt was made amongst the drapers' and manufacturers' wares before a muslin gauze was found, cheap enough and porous enough and yet not too flimsy for the purpose. It is now an important article of commerce, manufactured in enormous quantities, as it forms the basis of all the gauzes, antiseptic and aseptic, that are used at the present day. The even distribution of the antiseptic mixture through the gauze

presented the greatest difficulty of all. A description of the process will be found in the *Collected Papers* (vol. ii. p. 210, and *Lancet*, 1875, vol. i. p. 365). It is tedious reading, but gives no idea of the enormous number of tedious experiments which led up to the successful result.

When well made, the carbolic-acid gauze was an excellent dressing, of a pale yellow colour, soft and pliable, smelling very faintly but not unpleasantly of carbolic acid. A complete dressing consisted of a pad of gauze eight layers thick. In order to prevent the discharge from soaking straight through opposite the wound, and in order to force it to travel to the edge of the dressing before it could be contaminated by germs, a layer of thin mackintosh was placed between the seventh and the eighth layers. The outermost layer thus only served the purpose of keeping the mackintosh clean and in place. The material chosen for the mackintosh was what is known in the trade as "hat lining," and for a while it retained this peculiar name amongst the profession. As the commercial article had almost the same colour as the gauze, Lister decided to have it stained pink in order to prevent the possibility of the dressing being inadvertently applied inside out, in which case the security of the patient would have depended on the efficiency of a single layer of gauze. "Hat lining" is still used, though not for its original purpose but as a covering for splints and fomentations; and it is still often religiously dyed pink, though few know why—certainly not the manufacturers, or they would surely save themselves the unnecessary trouble and expense.

The only disadvantage of this gauze was one common to all dressings containing volatile antiseptics like carbolic acid. They deteriorate from evaporation unless kept in hermetically closed receptacles. Thus they lose an uncertain amount of their virtue from the very moment they are put on. Evaporation takes place of course very slowly; so slowly indeed that Lister thought there was a risk of some living germ escaping the influence of the acid if it fell upon the dressing in the momentary interval of its transference to the wound from the box in which the gauze was kept. He therefore always placed a few layers of gauze soaked in carbolic-acid

lotion next to the wound, or rather next to the protective, and thus eliminated this possible source of danger.

This was the "antiseptic gauze" *par excellence* for many years, in fact till 1889, when, after many trials of other materials, it was permanently replaced by one charged with the double cyanide of mercury and zinc, which is now the dressing commonly employed by those who use "antiseptic" as opposed to so-called "aseptic" methods. Without entering at present into the vexed question raised by these two words, it will be convenient to proceed at once to trace the steps leading up to the adoption of this "cyanide gauze."

When the antiseptic principle was at last grasped, and everyone recognized that it had no essential connection with carbolic acid, experiments in wound-treatment were made all over the world with various substances which the constantly increasing army of bacteriologists found to possess the power of killing micro-organisms, or of inhibiting their growth.

Before using any of them upon his fellow-men, Lister was in the habit of submitting them to laboratory experiments. Some he found untrustworthy, others more promising. A few of the latter he substituted for carbolic acid in the preparation of the gauze. Amongst these some were volatile; and, at first, impressed as he was with the advantages of a volatile antiseptic, he only used these for the purpose. Typical of this class were thymol and eucalyptus, but they proved to be much less efficient than carbolic acid, and to have no advantages over it.

The deterioration of dressings containing volatile antiseptics on exposure to the air, and the weight of evidence brought by Koch and others of the potency of the germicidal and inhibitory powers of corrosive sublimate and other non-volatile salts of mercury, led Lister to reconsider his position, and ultimately to adopt a non-volatile antiseptic in the gauze which he employed during the later years of his practice.

The word "inhibitory" requires some explanation. Koch had shown that, while an aqueous solution of corrosive sublimate of a certain strength was required to kill the spores of the bacilli of anthrax, a much weaker solution in a fluid

suitable for their growth, such as extract of meat, though it did not kill them, effectually prevented their development. Referring to this matter in 1884, Lister said:

"And thus Koch established in a most definite manner the distinction, and a very important one it is, between two different effects of antiseptic agents—one, the action by which the vitality of organisms is destroyed; and the other, that by which development is simply arrested, or prevented temporarily from occurring, without the vitality of the spores being interfered with. The former we may term 'germicidal action.' For the latter, it is somewhat difficult to find a good English term. I happened, I believe, to be the first to use the word 'inhibitory' in English physiology, by the advice of my old friend Dr. Sharpey, with reference to an early paper I was about to publish on what the Germans term the 'Hemmungs-Nervensystem'; and as this same word *Hemmung* is used by the Germans for this checking or suspending action of antiseptics, without destruction of vitality, and as it is very important that we should have some term which distinguishes the one action from the other, I may venture to employ this same word 'inhibitory'—a good old English word—for this action of antiseptics, and to speak of their 'inhibitory action' as distinguished from their 'germicidal action.'

Now, these properties of corrosive sublimate were such as no other antiseptic agent had ever been ascertained to possess in anything like such dilute solutions. With regard to our purposes in antiseptic surgery, the inhibitory action of the antiseptic would be sufficient, provided we be satisfied that our wound is left free from injurious organisms, and that the dressing which we apply itself contains no such organisms still alive. Then, all we require is that the dressing should be able to prevent the development of organisms from without into the discharges with which the dressing may be soaked. That is obvious." [1]

Before he began to work with sublimate, it had been much used in Germany, principally in the form of "sublimate wood-wool"; that is, pine-wood mechanically reduced almost to a state of powder and charged with the sublimate. Dressings of wood-wool were necessarily very bulky, and, in other ways, unsatisfactory; so Lister began a series of experiments with this mercurial salt and its compounds that extended over many years.

[1] "An Address on Corrosive Sublimate as a Surgical Dressing." *Brit. Med. Journ.* 1884, vol. ii. p. 803. *Collected Papers*, vol. ii. p. 296.

A prime difficulty in the use of the sublimate was that when it was added to an albuminous fluid such as blood or serum, a deposit formed which was then, and is by most physiological chemists still, called an albuminate of mercury, and which possessed comparatively weak germicidal powers. Lister held that this deposit was not a true chemical compound, but an association of particles such as occurs in a solution, and that in this mixture the sublimate still existed and retained its germicidal and inhibitory properties, though much weakened by its alliance with the albumen. Pure chemists,[1] who would like to know how Lister worked out such a problem, are referred to the interesting, but highly technical, account of it in the *Collected Papers*.[2]

The conclusions he arrived at had a twofold bearing upon the question of the practicability of using sublimate for surgical purposes. They showed:

1. That the germicidal activity of a mercurial lotion or dressing must not be calculated upon the amount of the mercurial salt it contains; because this activity is immediately weakened by contact with blood or serum.

2. That the soaking of a mercurial dressing with blood or serum, though it weakens the action of the drug, does not necessarily render it inert even in respect of its germicidal power, and may leave the inhibitory power more or less completely unimpaired.

Another difficulty in the use of corrosive sublimate arose from its solubility. Solubility might at first seem likely to prove advantageous, because it ensures activity. But it is really a defect, because it allows the antiseptic substance to be quickly washed out by a copious discharge, and it is doubly mischievous if this essential ingredient happens to be irritating to the skin, as is the case with corrosive sublimate. The first attempts to make a sublimate gauze resulted in disappointment for this very reason. The gauze was charged

[1] Pure chemists speak with an uncertain voice on this question. Observers differ as to the quantity of mercury with which albuminous substances combine, and point out that the question is complicated by the fact that there are several different kinds of albumen.

[2] *Collected Papers*, vol. ii. p. 299.

by steeping it in a watery solution of the sublimate, sometimes with the addition of a little gum arabic to prevent the dusting out of the irritating mercurial salt when dry. But it was found that the discharge, as it soaked further away from the wound, took up more and more sublimate till at last the solution was strong enough to raise a crop of pustules, or even extensive blisters, near the edge of the dressing.

These were great drawbacks. So, following the same line of thought that had guided him in the preparation of all his previous dressings, Lister looked about for some means of modifying both the solubility and the irritating quality of the sublimate.

At first he almost despaired of ever being able to use it, in anything like a concentrated form, as a surgical dressing. But, pondering over the strange interaction between sublimate and albumen, it occurred to him that the object might be gained by associating these two substances in the dressing. As to the source of supply, was there not the knacker's yard? One horse would yield several gallons of serum, and as the article was a drug on the market, the product would at least be cheap—no unimportant matter when hospital managers were constantly complaining of the outrageous cost of antiseptic dressings.

It turned out that serum and sublimate could be mixed in almost any proportions, and that a mixture of one part of the salt to one hundred of the serum yielded satisfactory results; that is, it was a trustworthy antiseptic and did not produce irritation. There was no difficulty about incorporating the serum with the gauze, so that he began to look forward to a blessed future, in which every hospital would prepare its own "sero-sublimate gauze," for so it was called, by steeping old rags or cheap muslin in the albuminous mixture, and when hospital managers would finally cease from troubling on the score of expense.

The sero-sublimate gauze was publicly recommended in 1884,[1] and was used for some time, though not very extensively. Lister heard of its having proved successful in such

[1] *Brit. Med. Journ.* 1884, vol. ii. p. 803. *Collected Papers*, vol. ii. p. 306.

distant countries as Spain and Poland. But in 1889, in an address to the Medical Society of London, he said, "Nevertheless it was not all that could be desired by any means; it was somewhat harsh mechanically; it was not very absorbent (a serious defect), and one of the materials of which it was made (the serum of horse's blood) was not always easily obtainable."[1] Moreover, though he did not say so in as many words, there is no doubt that it needed one of those rare minds, quite free from prejudice, to recognize that there was no sort of objection to making an antiseptic dressing out of horse's serum.

So he "was well disposed to look for something superior."

There are many antiseptic salts of mercury, some more soluble than corrosive sublimate, some less. Lister gave them all, or nearly all, a trial.

The most soluble and least irritating is "sal alembroth," a double salt of bichloride of mercury and chloride of ammonium, the quaint Arabic name of which recalls the fact that the Moors utilized its great solubility to prepare a fluid dense enough to be of use in estimating the specific gravity of diamonds. Lister prepared a gauze with it, but never publicly recommended its employment, as it presented in an exaggerated form the defects of solubility. But the manufacturers got wind of it, and placed it on the market, where its cheapness ensured a ready sale. It may indeed still be met with. It was stained blue for distinction, and called "blue gauze"; a useful enough dressing where rapid healing is expected, but most unsuitable for cases where there is likely to be much discharge.

Quite at the other end of the scale, being insoluble in water, though soluble in 3000 parts of blood serum, is the rather mysterious, because strangely constituted, double cyanide of mercury and zinc, which proved to be the most satisfactory of all the non-volatile antiseptic substances Lister ever used for incorporating in a gauze.

He came across it in this way. He was experimenting with the cyanide of mercury, which had weak germicidal, though powerful inhibitory properties, and possessed the

[1] *Lancet*, 1889, vol. ii. p. 943. *Collected Papers*, vol. ii. p. 309.

advantage of not coagulating albumen, but had the great defect of being intensely irritating to the skin.

In some ways then it was promising; but the irritation it set up made it unsuitable for use by itself, so it "naturally occurred" to him—a common phrase of Lister's—"that the cyanide of mercury might perhaps combine with some other cyanide and form a double salt, having advantages corresponding with those presented by sal alembroth as compared with bichloride of mercury." [1]

Several double cyanides were tried before that of mercury and zinc, the composition of which had not then been completely worked out.[2] It was known to contain much less mercury than zinc. In fact it was suggested to Lister by a chemist that he was practically only working with cyanide of zinc—a suggestion which he hailed with delight, because it would have been highly satisfactory to be able to dispense with the use of the poisonous mercurial salts. However, he found that though simple cyanide of zinc had very definite antiseptic properties, they were far inferior to those of the double salt.

The double cyanide is a very fine white powder. Owing to the difficulty of fixing it to the fibres of the gauze, troublesome dusting out of the powder, on shaking, took place in the first samples that were made. This was, in great measure, overcome by mixing it with starch. But even then Lister was afraid at first to use so insoluble a material dry, because he thought that possibly stray living germs resting on the surface of the dressing might be conveyed to the wound and pass into its deeper parts without ever coming under the influence of the antiseptic. This risk was obviously greater than in the case of the carbolic acid gauze with its volatile and soluble antiseptic. So he moistened the deepest layer with sublimate lotion. This simple and obvious

[1] *Collected Papers*, vol. ii. p. 313.

[2] In a note published in the *British Medical Journal*, 1907, vol. i. p. 795, and the *Collected Papers*, vol. ii. p. 329, it is thus described: "Professor Dunstan, of the Imperial Institute, who most kindly undertook to investigate its composition, found it to be a double salt of very unusual type, being a tetrazincic monomercuric decacyanide, $Zn_4Hg(CN)_{10}$. Its insolubility in water appears to be also a very unusual feature in a double salt."

safeguard had an unexpected result; the sublimate decomposed the double cyanide, producing irritating soluble salts The unexpected and, at the time, inexplicable consequence was that troublesome irritation of the skin occurred after all.

So the double cyanide was laid aside. But, after many disappointments with other compounds, he returned to it again, having in the meantime determined by experiments the real cause of the irritation of the skin, and overcome other difficulties in the manufacture of the gauze. A satisfactory way of fixing the powder was discovered accidentally. It was important that the gauze should be coloured, and it turned out that some of the dyes employed answered the purpose of fixing it much better than starch had done. The best of all was the hydrochlorate of mauveine, known in commerce by the name of purified rosaline. This imparted to the gauze a delicate heliotrope colour, which was a frequent source of admiration and comment from lady patients. It had another incidental but great advantage. The dye had a strong attraction on the one hand for the gauze and on the other for the double cyanide. So strong were these attractions that it could confidently be stated that any part of the gauze sufficiently deeply stained was sufficiently charged with the antiseptic salt.

The troublesome tendency to cause irritation was overcome, partly by getting some manufacturing chemists to take pains to produce a really pure article, freed by repeated washings from any soluble irritating cyanides that might be adherent to it, but chiefly by damping the whole dressing or moistening the deeper layers, not with sublimate lotion, as in his earlier attempts, but with carbolic acid lotion, which had no power of decomposing the double salt.

As finally perfected, the process of preparation was an extremely simple one. For a whole year Lister prepared his own gauze for use in hospital as well as in private practice, that is, until he had satisfied himself completely of its value. He advised that hospitals should make their own supply and so save expense. But before long it was made solely, and in very large quantities, by the manufacturers.

The double cyanide gauze is a most excellent dressing if only Lister's instructions be followed. Sometimes complaints are still made that it causes irritation. In nine cases out of ten this is because surgeons will insist on damping it with sublimate instead of carbolic acid lotion; in the remaining rare cases it is because the powder has been imperfectly washed by the manufacturers, an inexcusable mistake which makes the gauze unfit for surgical use.

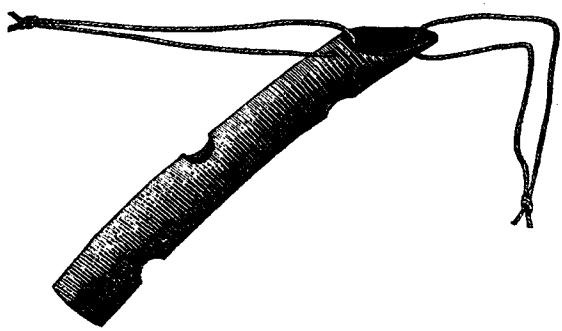
The origin and development of gauze dressings thus briefly summarized are recorded in many papers, a dozen or more, dealing with various matters and scattered over a period of nearly forty years. The amount of time and trouble involved and the innumerable researches, physical, chemical, biological and physiological, entailed, can hardly be estimated by those who did not witness the experiments, or have not had the opportunity of turning over the pages of Lister's "common place books." Some idea may perhaps be gathered from the accompanying note,[1] which deals with one comparatively

[1] "The experiment was performed in the following manner: A glass tube, such as this (three-quarters of an inch in calibre and three inches in length), open at each end, was packed with a certain weight of antiseptic dressing to be tested, say sublimate-wool, occupying about two inches of the tube; then a weighed quantity of serum, just enough to soak the wool, was poured in at one end of the tube held vertically; it was then left for about half-an-hour in a warm box at the temperature of the body, after being put into a stoppered bottle, to prevent evaporation; then the serum and the sublimate in the dressing having been allowed to act upon each other for about half an hour, a little more serum was poured in, the tube being in the same position as before. The result was that a certain quantity flowed out below, and was received into a test-tube. The lower part of the wool and the serum in the test-tube were next inoculated with putrid blood, diluted with ten parts of water, to prevent the smell being so great as to make one think that putrefaction existed when none had occurred, a tenth of a minim being applied by means of a suitable apparatus. Lastly, the wool-tube in its stoppered bottle, and the test-tube with a cap of thin mackintosh tied over its mouth, were replaced in the warm box. The object of this was to ascertain whether the dressing, after having been thoroughly soaked through and through with serum, would resist a potent septic inoculation; and also whether the fluid that had come through the dressing was itself an antiseptic fluid. If such should prove to be the case, we should have all the requisites we could desire for an antiseptic dressing. It was a very severe test, for it is comparatively rarely that we have such intensely putrefying substances applied to the surface of our surgical dressings, and it is also comparatively rarely that the dressings are soaked so very thoroughly with blood or serum." "An Address on Corrosive Sublimate as a Surgical Dressing," *Brit. Med. Journ.* 1884, vol. ii. p. 803. *Collected Papers*, vol. ii. p. 301.

unimportant matter, the routine method of testing the trustworthiness of antiseptic dressings, and, when it is remembered that each new sample had to be submitted to some such test, it will be recognized that this alone was no light matter.

Although these researches were continued almost to the end of his professional career, they have been described together here, because a better estimate can thus be formed of the way in which Lister worked at such a subject than if each step were recorded in its proper place in the history of his life.

About the same time as the introduction of the spray and the gauze, Lister did much to familiarize the profession with



the advantages of indiarubber drainage tubes. He was the first to use them for draining recent wounds. They were originally introduced by Chassaignac in 1859 for the treatment of abscesses, but his work was almost unknown in this country. Drainage tubes of other materials had long been employed, but to a very limited extent. Chassaignac's drain was simply an indiarubber tube of small calibre, provided with lateral holes to admit the discharge, such as are made in agricultural drain-pipes. Lister's only modifications consisted in using tubes of larger bore when occasion required, and in cutting the outer end in such a way, either obliquely or transversely, that it was always flush with the surface of the skin. This was to prevent buckling and consequent obstruction of the tube by pressure of the dressing. He also attached loops of silk to the outer end, as is shown in the accompanying

figure, in order to keep the tube from slipping either in or out when the dressing was firmly bandaged over it.

Drainage of wounds became a most important matter in the early days of antiseptics, as has been already explained. At first a piece of lint soaked in carbolized oil was used for the purpose, but this was not always satisfactory. Lister was evidently not then acquainted with Chassaignac's writings, if we may judge from his account of the first occasion on which he used an indiarubber tube. The case, which occurred in 1871, has become classical, because the patient was no less a personage than Queen Victoria. It was not reported till long after, in 1908, and then in the following modest and somewhat cryptic fashion.

" I continued to use a strip of lint as a drain for about five years with perfectly satisfactory results. But in 1871, having opened a very deeply seated acute abscess of the axilla, I found to my surprise, on changing the dressing next day, that the withdrawal of the lint was followed by escape of thick pus like the original contents.

It occurred to me that in that deep and narrow incision, the lint, instead of serving as a drain, might have acted like a plug, and so reproduced the conditions present before evacuation. Taking a piece of the india-rubber tubing of a Richardson's spray producer that I had used for local anaesthesia at the operation, I cut holes in it and attached knotted silk threads to one end, so improvising a drainage-tube. This I put to steep for the night in a strong watery solution of carbolic acid, and introduced it in place of the lint on changing the dressing next morning. The withdrawal of the lint had been followed by discharge of thick pus as before; but next morning I was rejoiced to find nothing escape unless it were a drop or so of clear serum. This rapidly diminished and within a week of the opening of the abscess I was able to take leave of my patient, the discharge from the abscess cavity having entirely ceased." [1]

Without knowing who the patient was it might be wondered that so simple a case should have detained him for a week. The Queen was at the time at Balmoral, and Lister, who was appointed Surgeon in Ordinary in Scotland in 1870, was called in to do the operation. Possibly the fact that his friend Sir William Jenner was in attendance may have had something to do with it. He used to tell how, having turned the ether

[1] *Lancet*, 1908, vol. i. p. 1815. *Brit. Med. Journ.* 1908, vol. i. p. 1557. *Collected Papers*, vol. ii. p. 367.

spray into account by using it as an antiseptic spray, he entrusted it to Sir William at the changing of the dressings. By accident some of the pungent vapour of carbolic acid reached the eyes of the august patient; and, when her Majesty complained, Jenner excused himself by saying that he was "only the man who worked the bellows," which was a characteristic remark of the great physician, and a good comment on the difficulties in the use of the hand spray. In spite of the little *contretemps*, when Lister left Balmoral the Queen described the whole performance as "a most disgreeable duty most agreeably performed."

As long as strong lotions were applied to operation wounds very free drainage was essential. After the introduction of the spray and the more sparing use of milder lotions, the initial discharge was much less and the necessity for drainage proportionately diminished. So that in certain cases where at one time Lister had been in the habit of inserting four long tubes he at last used only a single short one.

He foresaw that drainage might some day become superfluous. In 1890 he said:

"I have not yet ventured to make the experiment on any large scale, although I have long had it in contemplation. It is a serious thing to experiment upon the lives of our fellow men, but I believe the time has now arrived when it may be tried. And if it should succeed, then perhaps may be fulfilled my early dream. Judging from the analogy of subcutaneous injuries, I hoped that a wound made under antiseptic precautions might be forthwith closed completely, with the line of union perhaps sealed hermetically with some antiseptic varnish, and bitter was my disappointment at finding that the carbolic acid used as our antiseptic agent induced by its irritation such a copious effusion of bloody serum as to necessitate an opening for its exit; hence came the drainage of wounds. But if we can discard the application of an antiseptic to the cut surfaces, using sponges wrung out of a liquid that is aseptic but unirritating, such as the 1 to 10,000 solution of corrosive sublimate, we may fairly hope that the original ideal may be more or less nearly attained." [1]

And further on in the same paper he adds:

"It would be a grand thing if we could dispense with drainage altogether."

[1] *Brit. Med. Journ.* 1890, vol. ii. p. 377. *Collected Papers* vol. ii. p. 337.

He did not live to see the fulfilment of this tentative prophecy. Not that drainage of wounds is altogether a thing of the past, or ever will be. But since it has been the almost universal custom to apply no antiseptic substance at all to recent wounds made by the surgeon through unbroken skin, so that the divided tissues are subjected only to mechanical and not to chemical irritation, most of them are now habitually sewn up from end to end and do actually heal by first intention.

It must, however, in fairness be added that not infrequently they require partial reopening and drainage on account of accumulation of serum; and it is more than doubtful whether, taking the average of a large number of cases, more rapid healing is secured by modern methods than would be obtained if Lister's custom of draining all wounds for a few hours were still followed. Complete closure saves trouble and a slight amount of risk, and often leads to results so brilliant that the occasional failures, which when they do occur may lead to troublesome delay, are easily forgotten.

The spray, the gauze and the drainage tube each involved the consideration of fundamental questions. This was not the case with the testing of the new antiseptic substances which, from time to time, were brought forward. Only one of these therefore, and that for special reasons, will now be mentioned.

Boracic or boric acid, the active principle of the popular household remedy borax, had been successfully employed in the preservation of meat, and Lister, having heard of this, began to use it as an antiseptic in 1871. In 1876 it formed the subject of the following interesting letter from Pasteur:

"PARIS le 29 Juin 1876.

MONSIEUR ET CHER CONFRÈRE,

Je m'empresse de vous remercier de vos deux envois de ce jour dont je ferai bon usage. Votre méthode antiseptique, bien plus négligée en France qu'à l'étranger, commence à être pratiquée et appréciée à sa valeur. Dans le courant de la semaine dernière, j'ai moi-même assisté à une opération de l'extraction d'une tumeur cancéreuse du sein droit, par le Dr. Guyon, à l'hôpital Necker.

La guérison a été d'une promptitude merveilleuse. M. le Dr. Guyon est très satisfait des résultats qu'il obtient en suivant vos prescriptions. Le grand ennui de la méthode est dans l'engourdissement que procure à la main de l'opérateur le contact de l'acide phénique. À ce propos je prends la liberté de vous dire que dans un travail en cours d'exécution, avec la collaboration de M. Joubert, sous-directeur de mon laboratoire, nous obtenons des effets antiseptiques remarquables de l'emploi de l'acide borique, en solution dans l'eau. L'acide phénique, par exemple, ne s'oppose pas au développement du ferment ammoniacal de l'urine, tandis que l'acide borique l'empêche complètement à des doses très faibles. Je serais extrêmement heureux que vous prissiez la peine d'expérimenter ce nouvel antiseptique en lotion et en pulverisation. S'il a la valeur que je lui attribue, personne mieux que vous n'est capable de le reconnaître. Vous savez que l'acidité de ce produit est des plus faibles, nullement irritante, que les plaies et la vessie pourront le supporter facilement. Vous verrez si son association avec de très faibles proportions d'acide phénique serait preférable à l'emploi de la solution pure.

En même temps que cette lettre, je mets à la poste, à votre adresse, un exemplaire d'un ouvrage que je publie cette semaine même, sur la fermentation en général et en particulier sur la fermentation de la bière. Certains chapitres de ce livre vous intéresseront. Vous y verrez que je me suis permis d'insérer au chap. III. la lettre si honorable pour mes travaux que vous m'avez adressée en 1874 et qui est, avec une autre de Tyndall, également reproduite à la fin de l'ouvrage, un de mes plus beaux titres de gloire et dont je suis très fier.

Je vais m'occuper de faire traduire tout de suite les deux brochures que vous venez de m'envoyer. Je ferai connaître à cette occasion le résumé des résultats si remarquables que vous obtenez par votre méthode et qu'on a obtenus sur le continent.

Veuillez agréer, monsieur et cher confrère, la nouvelle expression de mes sentiments les plus respectueusement adressés.

L. PASTEUR." [1]

Boric acid has been extensively used in surgical practice from that day to this. It has definite germicidal powers, but less than Pasteur had thought. It occurs in the form of

[1] "DEAR SIR AND CONFRÈRE,

I hasten to thank you for the two papers you have sent me to-day of which I will make good use. Your antiseptic method, which is much more neglected in France than abroad, is beginning to be appreciated at its proper value. In the course of last week I was myself present at an operation for the removal of a cancerous tumour of the right breast by Dr. Guyon at the Necker Hospital. Healing took place with marvellous rapidity. Dr. Guyon is well satisfied with the results which he obtains

very smooth and bland crystals, or in powder, not very soluble in cold water, and it is employed in surgery either in the form of a powder or as an ointment, or diffused amongst the fibres of lint as "boracic lint." Taking advantage of its far greater solubility in boiling than in cold water, Lister succeeded in introducing a very large amount of boric acid into the boracic lint, much more than would be at once dissolved and washed away by the discharge from a wound, the temperature of which never reaches 100° F. Thus he secured another "ideal dressing," *i.e.* one containing a store of the antiseptic sufficient to last for a considerable time. Like so many of Lister's principles this is now forgotten. Boracic lint is commonly employed for so-called "boracic fomentations," in the preparation of which the nurse first steeps the lint in boiling water and then wrings it out with all her might. The hotter the water, and the more energetic the nurse, the less of the antiseptic is left in the lint; the nett result is much the same

by following your instructions. The great annoyance of the method consists in the numbness of the operator's hands produced by contact with carbolic acid. In connection with this, I take the liberty of telling you that, in the course of an investigation which is being carried out with the help of M. Joubert, assistant director of my laboratory, we are obtaining remarkable antiseptic results by the use of a solution of boric acid in water. Carbolic acid, for example, does not interfere with the development of the ammoniacal ferment of urine, whilst boric acid completely prevents it in very weak doses. I should be extremely pleased if you would take the trouble to experiment with this new antiseptic as a lotion and as a powder [spray?]. If it has the valuable properties which I attribute to it, no one is better able to recognize them than yourself. You know that the acidity of this substance is of the weakest, not in the least irritating, that wounds and the bladder can stand it easily. You will see if using it together with small proportions of carbolic acid would be preferable to the employment of the pure solution.

I am forwarding to your address at the same time as this letter a copy of a work that I am publishing this very week on the fermentation of beer. Some chapters of this book will interest you. You will see that I have taken leave to insert in chapter iii. the letter you wrote to me in 1874 which speaks so honourably of my work, and which, with another from Tyndall, also reproduced at the end of the work, is one of the things of which I am most entitled to boast, and of which I am very proud.

I shall make it my business to have the two pamphlets you have sent me translated at once. I shall seize this opportunity for making known the summary of the very striking results that you obtain by your method and which have been obtained on the continent.

Accept, my dear confrère, the renewed expressions of most sincere respect.

L. PASTEUR."

as if plain lint had been used, and incidentally the waste of much labour and good material.

Side by side with Pasteur's letter may be placed the following from Charles Darwin, drawing attention to benzoic acid; not that he was the discoverer of the antiseptic properties of benzoic acid, but on account of its special interest, and because it shows how Lister's work was attracting the attention of biologists.

"Oct. 7. 1878. DOWN.
BECKENHAM. KENT.

MY DEAR SIR,

As this note requires no answer I will not apologize for making a small suggestion to you. I believe that you are still continuing your most valuable observations on Bacteria and their allies. Now it seems to me probable (or at least worth a trial) that Benzoic acid would be a most deadly poison to them. I think so because a minute dose of a solution of 1 part of the acid to 437 of water, when absorbed by the glands of Drosera, killed the protoplasm within them in a surprising manner. The glands presented in 12 min. the same white appearance as if the whole plant had been immersed in boiling water.—This is described in my *Insectivorous Plants*, p. 195.

I have been told that you employ borax as a disinfectant; and if this is so and it depends on the destruction of Bacteria, it is odd that *Boracic Acid* was not in the least injurious to Drosera.

Pray forgive me for troubling you, if my suggestion appears to you useless; I remain with the highest respect,

Yours faithfully,

CHARLES DARWIN."

It is now time to tell of the reception Lister's teaching met with at home and abroad. His critics, if they followed his instructions in their entirety, were working with carbolic acid lotions and gauze, the steam spray, and thoroughly draining their wounds. If they were fair men they were bound to act as if they had a whole-hearted belief in the germ theory.

CHAPTER XX

RECEPTION OF LISTER'S TEACHING AT HOME

In Great Britain the first cordial reception of Lister's announcement that he had discovered a new principle of treatment was, as we saw, followed by sharp criticism from some eminent and some less distinguished surgeons.

After this not much was said till the year 1869, when the British Medical Association met in Leeds. Mr. Nunneley, a well-known surgeon of that city, gave the Address in Surgery,[1] the larger part of which (occupying eight columns of the *Journal*) was devoted to a strong condemnation of the antiseptic system, couched in the flowery language which too frequently took the place of argument in the speeches and writings of the older surgeons of that time. He referred to a paper by Hughes Bennett,[2] the well-known Professor of Physiology in Edinburgh, in which he opposed the germ theory. Nunneley professed himself more convinced by the arguments of Pouchet and Hughes Bennett than by those of Pasteur and Lister. He said, however, that he had never tried the antiseptic treatment, but that his colleagues had done so for three years without obtaining better results than his own, and that its employment in Leeds was now the exception.

A shower of letters followed in the medical press. Nunneley's statement with regard to the practice of his colleagues was disavowed, but several of the writers, some even from

[1] *Brit. Med. Journ.* 1869, vol. ii. p. 143.

[2] "The Atmospheric Germ Theory." A Lecture delivered to the Royal College of Surgeons in Edinburgh, January 17, 1868, by John Hughes Bennett, M.D., *Edin. Med. Journ.* 1868, vol. xiii. p. 816.

Glasgow, approved of his address, and echoed his attack in similar vague and ornate language. Lister, fearing that silence might be misunderstood, wrote to the *British Medical Journal*:

" SIR,

Mr. Nunneley's recent attack (see the *British Medical Journal*, Aug. 7th, 1869) seems to me little calculated to impede the progress of the antiseptic treatment; nor do I feel called upon to point out in how many respects he has misapprehended my published views. That he should dogmatically oppose a treatment which he so little understands, and which, by his own admission, he has never tried, is a matter of small moment. But I was grieved to find him stating that his colleagues, who had once adopted the system, were now abandoning it as untrustworthy. It was, therefore, with much pleasure that I received a very different account from Mr. Teale in a letter which, with his permission, I now request you to publish.

I am, etc.,

JOSEPH LISTER.

GLASGOW, 24th August 1869.

' 20, PARK ROW, LEEDS, Aug. 11th 1869.

MY DEAR SIR,

May I call your attention to the attack upon the " antiseptic treatment" in Mr. Nunneley's surgical address, in which he quotes the experience of his colleagues as unfavourable to it.

I think it due to yourself to inform you that Mr. Nunneley was in no sense justified in making such a statement; that we still use, and have as much confidence as ever in antiseptic treatment; and that we hope shortly, in some way or other, to have Mr. Nunneley's misstatements corrected.

Any want of success in our practice may fairly be attributed to imperfections in carrying out your rules.

Yours truly,

T. PRIDGIN TEALE.' "[1]

In spite of strong pressure brought to bear on Mr. Nunneley by his two colleagues to withdraw his incorrect statement about their practice in the three medical journals in which his address had been published, he flatly refused to do so, and, although it is clear that they contemplated taking some further steps themselves, they probably thought the publication of Mr. Teale's letter to be a sufficient vindication of their position.

[1] *Brit. Med. Journ.* 1869, vol. ii. p. 256.

Dr. Thomas Keith's contribution to the discussion was not the least important. He began by saying,

"In the last number of your *Journal*, Dr. D. Campbell Black of Glasgow refers to my cases of ovariotomy in a way that must lead any one to suppose that I have no faith in the antiseptic treatment of wounds." After saying that this was a complete mistake, he concludes thus: "I think I am only now beginning to realise what Mr. Lister's antiseptic method and his carbolised animal-ligatures are yet to do for surgery. I cannot think, as Dr. Black would have us to believe, that sentiments similar to his own on the value of Mr. Lister's discoveries are entertained by the 'bulk of the profession' in Glasgow. Mr. Lister has raised the medical school of that city and given it a name; it seems hard that on the eve of his leaving it there should be found even one to cast a stone at him." [1]

The Leeds incident was followed by a time of truce. Lister continued to place his views before the profession in addresses and papers dealing with such subjects as "the effects of the antiseptic system of treatment upon the salubrity of a surgical hospital" [2] and "a method of antiseptic treatment applicable to wounded soldiers in the present war" [3] (the Franco-German war of 1870).

Of these one of the most important was the Address in Surgery delivered at the Plymouth meeting in 1871.[4] The annual meetings of the British Medical Association, then as now very largely attended by general practitioners from all parts of the kingdom, and by a good sprinkling of specialists from this and foreign countries were, at least as much as at the present day, occasions for the production of first-class scientific papers and the promulgation of new matter. Very distinguished men were usually chosen to give the addresses in medicine and surgery, which were accordingly looked forward to with an anticipation which was seldom disappointed.

Lister at the last moment broke away from his work, and found himself almost accidentally at Looe in Cornwall, intending to put the finishing touches, if they may be so called, to

[1] *Brit. Med. Journ.* 1869, vol. ii. p. 335.

[2] *Lancet*, 1870, vol. i. pp. 4, 40, and *Collected Papers*, vol. ii. p. 123. *Lancet*, 1870, vol. ii. p. 287, and *Collected Papers*, vol. ii. p. 156.

[3] *Brit. Med. Journ.* 1870, vol. ii. p. 243. *Collected Papers*, vol. ii. p. 161.

[4] *Brit. Med. Journ.* 1871, vol. ii. p. 225. *Collected Papers*, vol. ii. p. 172.

his address, prepared with the usual desperate haste, which even on the most important occasions he seemed unable to avoid. Writing to his brother on August 4th, he says:

"LOOE, CORNWALL, 4 Aug. 1871.

Loo, the Scotch for love, is very nearly the same as my address above given: and certainly it is a lovely place. We arrived here late last evening, having left Edinburgh by 10.15 train the night before. We had only just time to drive from King's Cross to Paddington and get some breakfast before the express for Plymouth started. I had been so driven in one way or another that we did not decide where we should go till we started. Before we reached London we decided to go at all events to Plymouth, and before we got there we concluded, by aid of Murray's 'Devon and Cornwall' and a Cornish gentleman in our compartment, to try our luck here. But before getting out of the train at Menheniot (for Looe) we enquired if any conveyance went to Looe and found that an omnibus meets that one train of all the trains in the day. So we accomplished the seven hilly miles satisfactorily, and though the Ship Hotel recommended by Murray was quite full ... the landlady found us lodgings over the provision shop." He goes on to describe a country stroll and the beauties of the place, and then adds: "*Withal* I got my address licked into shape as regards the first rough licking. But I perceive plainly that I shall not have time to write it all. So there will be nothing for it but an extempore affair, to be taken down by a short-hand writer."

The address was written, at least "the beginning portion and the last sentence," as they rested on mossy banks in the woods, and this is how he describes its delivery in a letter to his brother, the latter part of which is unfortunately lost:

"DEVONPORT 10 August 1871.

The address is delivered, and I think I may say with thankfulness, successfully. A large ball-room in the chief hotel of Plymouth was the scene of action, and it was pretty nearly filled. Having been told that the room was an extremely difficult one to make oneself heard in, I exerted myself to speak loudly and distinctly, and I believe I made everyone hear. The attention with which I was listened to was all that I could desire. I began at about 11.15 and about 12.55 the president passed me a slip of paper asking if I was aware that there was a rule to the effect that the addresses were not to occupy more than an hour. It was a good thing that I did not know of the rule. For I could not have said what I wanted in the time. After an apology for addressing them on a topic with which

my name was so much associated, I divided my subject into three heads, 1st. Some facts relating to the theoretical basis of the treatment. 2nd. An exhibition of the means we now employ and the mode of using them, so far as that could be done on a table. 3rd. A relation of striking cases to convince them that by such means employed on such a principle results might be securely and easily obtained which without antiseptic management the surgeon would not be justified in aiming at. The first division was written at lovely Looe. The second was finished thinking of at 3 this morning and the third was finally arranged and the dates and facts looked up in note books as well as memory after breakfast this morning. At 10.30 the Mayor's carriage was at the door to take us to the hotel. The notes of one of my most important cases were looked over as I drove along in the carriage. When I got to the room I was warmly received as I walked up to the platform; and while a report on some matters of business was being read, I arranged my spray."

The rest of the letter is missing. The description gives a fair account of the scope of the address.

Four years later, in a paper extending over seven numbers of the *Lancet*,[1] he described the improvements in the details of the antiseptic treatment that had taken place in the interval; and in the same year he gave two impressive "Demonstrations of Antiseptic Surgery before Members of the British Medical Association" in Edinburgh.[2]

It cannot be said, therefore, that as far as Lister himself was concerned, he had failed to keep the matter before the eyes and the ears of the profession. Moreover, Edinburgh was not too remote for many of the younger surgeons in London and all of those in Scotland who cared to do so to test the truth of what he said by personal observation.

And yet it is not too much to say that in London it made but little way until these younger men had reached a sufficient degree of seniority to have the charge of wards, and that, even in Edinburgh and Glasgow, some of the old spirit and much of the old practice prevailed well on into the seventies, when Lister's own pupils began to occupy positions on the full staffs of their hospitals.

[1] *Lancet*, 1875, vol. i. pp. 365, 401, 434, 468, 603, 717, 787. *Collected Papers*, vol. ii. p. 206.

[2] *Edin. Med. Journ.* vol. xxi. 1875-6, pp. 193, 481. *Collected Papers*, vol. ii. p. 256.

This may seem strange to those who were not taught by, and have not served under, the surgeons of the old school, or who do not appreciate the limitations imposed upon assistant surgeons in those days. There was not, so to say, more than enough of either hospital or private practice, at that time, to go round, as there is now ; and the seniors stuck with much tenacity to their posts, thus allowing but little opportunity to the juniors to expand themselves. Night and day, Sundays and week days, they would turn out to do their " casualty " work. Visits to continental schools, week-ends in the country, and long summer holidays were almost unknown, and the orthodox point of view was that of a well-known surgeon who said, "My moors are in Old Burlington Street."

It is only fair to make allowances for these men and to add that the description applies only to a class, amongst whom there were striking exceptions. They were following in the steps of their predecessors. They had been brought up to think much of the art and comparatively little of the scientific side of surgery. Their minds were not trained for the reception of such an abstract idea as that of the germ theory, or to weigh the arguments of its supporters against the louder and more incessant replies of its opponents. For the most part indeed they were convinced that it was the dream of cranks and enthusiasts. It was therefore incredible to them that the true light had been revealed to such men, that their own time-honoured creed about inflammation was a delusion, and that a complete change in their methods of treatment was essential.

Still, for decency's sake the thing had to be given a trial. But it was done in a perfunctory manner, with a scornful half-faith or no-faith ; and as the new method involved great difficulties, even for enthusiastic young disciples working in the old surroundings, it is no wonder that the seniors, almost without exception, failed to obtain Lister's results. Their failures caused them little sorrow, but rather the satisfactory feeling that, after all, this new doctrine had nothing in it, and that they had not all their lives been following cunningly devised fables.

When I was a student full of the confidence of youth, and doing my best to educate my superior officer—no less dis-

tinguished a man than Sir John Erichsen—I lamentably failed with a compound fracture, for reasons now easy to recognize, and received from him the stern injunction, "No more antiseptics." Erichsen was by no means a bigoted man, and he was always very friendly to Lister. He was simply old-fashioned, and would have paid little attention to, and perhaps hardly have understood, Lister's explanation of my failure:

"I am sorry to hear of your case of compound fracture. I should think from thy account that the slough at a little distance from the plaster was probably the cause of the mischief. When fracture occurs from direct violence there is always a risk of portions of the skin being killed at some little distance from the seat of fracture, and putrefaction may then spread from the slough to the seat of fracture along blood extravasated under the skin. So I now always wrap lac plaster all round the limb for a considerable distance both upwards and downwards, and examine the skin carefully the first two days for the chance of sloughs showing themselves.

Of course if putrefaction once does spread into the wound, it may occasion very extensive sloughing.

Thee will have to learn to bear sad disappointments as thee go on: at least if thee do much in the way of Surgery. But I hope thee will never lose the feeling of deep interest in the welfare of thy patients which I am glad to see thee showing in this case.

We have got a capital case of compound fracture of the thigh, by direct violence, with great swelling of the limb from effused blood when he was admitted; with the swelling now all gone, and no pus whatever up to this time, between 3 and 4 weeks from the accident. We have also a bad case of compound fracture and dislocation of the ankle doing well. You must not let one bad case discourage you."

Amongst those who honestly endeavoured to give the new treatment a trial were men renowned for their scientific attainments. But even of these many failed at first to grasp Lister's fundamental idea. The most distinguished of all, Sir James Paget, a man devoid of jealousy and of a conspicuously open mind, in a clinical lecture, in 1869,[1] described a case of compound fracture of the leg, treated, as he no doubt thought, by Lister's method, on which he made the following comment:

"Collodion was put on at once, and then carbolic acid applied. You know we are trying the effects of carbolic acid for compound

[1] "Clinical Lecture on the Treatment of Fractures of the Leg," by James Paget, F.R.S., D.C.L. *Lancet*, 1869, vol. i. p. 317.

fractures and some other forms of injury, after the manner which has been so strongly recommended by Professor Lister. In this case I would say that the carbolic acid was applied, if not with all the skill that Professor Lister would employ it, yet with more than is ever likely to be generally used in the treatment of fractures; and yet it certainly did no good. I will not say that it did harm; if it did harm, it was rather through my fault in leaving it too long when the wound should have been left open to discharge itself. But, at any rate, carbolic acid, applied here with a considerable amount of care and skill, failed altogether to attain its end; for, three days after the fracture, we observed that the limb was becoming the seat of inflammation of the acutest kind," etc.

To this, with an evident touch of sadness, Lister thus replied on 7th March in a letter to the *Lancet:*

"SIR,—In a clinical lecture, published in yesterday's *Lancet*, Mr. Paget mentions a case of compound fracture of the leg, in which carbolic acid was used, but, as he says, 'certainly did no good.' He pointedly alludes to special care having been taken to carry out the treatment 'after the manner . . . recommended by' myself. Permit me to point out in your columns that the practice followed in this instance had very little in common with anything I have advised.

We are informed that 'the wound was sealed up with collodion, and twelve hours afterwards carbolic-acid putty was applied.' Now, in the first place, I would remark that collodion and carbolic acid act antiseptically upon totally different principles; the former mechanically excluding the air with its floating organisms, while the latter operates upon the putrefactive germs as a poison. Collodion is naturally untrustworthy, since we can have no security that the causes of putrefaction have not been introduced into the wound before we seal it up. But to combine collodion and carbolic acid is to do not only what I never thought of recommending, but what I should regard as objectionable, since the former would tend to obstruct the free exit of the sero-sanguineous effusion which the stimulating action of the latter would promote.

Secondly, if the carbolic acid was to be used at all, why defer the employment for twelve hours? To apply the antiseptic dressing as soon as possible after the infliction of the injury, is a point which I have from the first insisted on.

Thirdly, I regard it as very important, more especially when any considerable time has elapsed after the accident, to inject a solution of carbolic acid into the wound and diffuse it freely among the extravasated blood, so as to destroy any putrefactive particles that may be disseminated in it. This precaution was omitted in the case referred to.

To seal the wound in compound fracture with collodion, and twelve hours later to employ a merely superficial carbolic-acid dressing, is certainly not to act in accordance with the antiseptic system.

Had this lecture proceeded from anyone less deservedly eminent than Mr. Paget, I should not have felt called upon to notice it. But as anything from such an authority is calculated to have great influence with the profession, I have felt reluctantly compelled to allude to the matter thus publicly.

I am Sir, your obedient servant,

JOSEPH LISTER." [1]

In a letter to his father (March 15th, 1869), Lister said:

"I wrote a private letter to Mr. Paget, telling him how I regretted being obliged to write to the *Lancet*, and offering to instruct any young student of his he may like to send. One of the Assistant Surgeons of St. Bartholomew's hospital (where Paget is) came here for one day last week, and expressed himself as greatly interested and quite satisfied. But one day is too short a time."

Such flying visits were almost useless. The *Lancet* suggested a better way for enabling London to make up its mind:

"Can we not have this treatment fairly and crucially tried in London? There are, unfortunately, London hospitals which afford only too good a field for testing the system. It is to little purpose to say it has been tried, or, as some of our surgeons assert, that there is no need for it. It has taken Professor Lister five or six years to bring his own antiseptic treatment to its present degree of perfection; and we have no reports of anything like similar pains being taken in any of our London hospitals, while we have reports which show how great is the need of some such agent." [2]

The writer goes on to suggest that a notoriously unhealthy ward in a London hospital should be subjected to Lister's treatment, "only," it adds, "this would have to be applied by those in whom Mr. Lister had confidence."

Nothing, of course, came of this suggestion, and there was little or no progress in London, as may be gathered from the address in Surgery by John Wood of King's College Hospital, on the occasion of the meeting of the British Medical Association in London in 1873,[3] about which Lister wrote in a letter

[1] *Lancet*, 1869, vol. i. p. 380. [2] *Lancet*, 1870, vol. i. p. 91.

[3] *Lancet*, 1873, vol. ii. p. 182.

to his brother on August 12th. "The Berlin Professor [no doubt Bardeleben] has arrived to-day. He is evidently working our system in right good earnest, and has banished pyaemia from what was formerly one of the unhealthiest of continental hospitals. He is much disgusted with the address in Surgery at the Association Meeting."

On the whole, as time went on, there was a tendency for apathy to pass into opposition. To mention antiseptic surgery was to cause irritation, or at least to elicit a scoff or a sneer; and Lister's name became to London surgeons like that of Aristides the Just to the Athenians.

If any one should think that the case against the majority of London surgeons has been overstated they should read the report of a confused debate at the Clinical Society of London which took place in 1875.[1] The antiseptic system was introduced incidentally on the report of certain cases supposed to have been treated antiseptically, but in none of which the treatment was properly carried out. It is almost incredible that the leading London surgeons could unblushingly discuss such a vital question in so loose a manner. It can only be explained by the assumption that they had no conception of its importance; and yet the meeting took place very shortly after Lister's striking demonstrations to the British Medical Association at Edinburgh.[2] The comments of the *Lancet*[3] are instructive:

"Mr. Lister and his disciples are themselves to blame for much of the obscurity that overshadows this question, inasmuch as they have never yet openly and fairly met the challenges that have been thrown out to them to produce the statistical results of their practices, say, for five or six years past. . . . Notwithstanding the very able papers on the recent improvement in the details of antiseptic surgery which Mr. Lister lately published in our columns, followed as they were by the demonstrations at Edinburgh at the meetings of the British Medical Association, there is less antiseptic surgery practised in the metropolitan hospitals than ever there was."

The article goes on to refer to other rival systems, such as the "open method" advocated by Humphry of Cambridge,

[1] *Lancet*, 1875, vol. ii. pp. 562, 628, 737.

[2] See p. 372.

[3] *Lancet*, 1875, vol. ii. p. 565.

that of Spence who used warm water and tincture of iodine, or that of Callender who trusted to cleanliness alone, for all of which brilliant results had been claimed. Further on it is said,

"Oddly enough, there is at least one metropolitan hospital where one surgeon follows, strictly and exclusively, Lister's plan, and the other surgeons as persistently reject it. Here, one would think, there is some ground on which to stand and view impartially the merits of the two modes of practice. What is the result? After the experience of several years, not to put too fine a point on the matter, it is found that the success of the antiseptic system is certainly not greater than that of the ordinary methods, and it is stated to be actually less."

The following week the *Lancet* returned to the charge: "Happily, it is no part of the business of a clinical surgeon to bolster up theories, be they good or bad, or to make facts rigidly conform to them. The germ theory may be perfectly well founded; but nine surgeons out of ten do not care much whether it is or not, so long as they cure their cases and reduce their mortality to the lowest possible degree."[1] In these words the mental attitude of the average London surgeon in 1875 was accurately described.

Four years passed, with some progress indeed, but more in the way of spreading conviction amongst the rising generation than in that of successful practice by their elders. So when it was known that the address in Surgery at the meeting of the British Medical Association in Cork, in 1879, had been entrusted to Mr. Savory,[2] some curiosity was excited by the open secret that he meant to tackle the subject of antiseptic surgery. Savory was one of the most thoughtful, most eloquent and best known London surgeons of the day, and on the staff of St. Bartholomew's Hospital, then as now the most influential London school. He was a man of conservative tendencies and unshakable convictions, who must often have felt the satisfaction expressed in the words of Sir George Jessel, "I may be wrong, but I have no doubts." He was always consistently opposed to Lister's views, but he was much too clever not to understand the argument, though at this time and probably throughout his life he did not believe

[1] *Lancet*, 1875, vol. ii. p. 597.

[2] Afterwards Sir William Savory.

that the premisses were true. Possibly he may have recognized that putrefaction was caused by germs, but if so he did not think it possible to exclude them from wounds; and he was clearly convinced that Lister's attempts to prevent suppuration were no more successful than his own.

Comments upon cases in the course of his address showed that he had no real knowledge of what was going on in Lister's wards (he was then in London). References to inflammatory blushes about wounds, and the "comforting" effect of his favourite dressing, the bread poultice, were clear evidence that inflammation was common in his practice, and that consequently there was often pain which called for "comforting" applications. He made no pretence that erysipelas and pyaemia had been banished from St. Bartholomew's Hospital, but he considered that an annual average of about 6 cases of pyaemia, 20 of erysipelas, and 26 of blood-poisoning following operations and injuries represented as good a result as it was reasonably possible to expect.[1] He attributed all recent diminutions in mortality to improvement in hospital hygiene. Finally he made the usual demand for statistics and produced those inevitable tables of mortality after amputations and major operations which were really quite beside the mark.

The clamour for statistics was natural, and came from many quarters; but such as were available for comparison would have been useless, and Lister wisely refrained from embarking to any large extent in the barren contest. Something would have been gained if statistics could have shown the percentage of cases in which suppuration occurred and the incidence of septic diseases amongst compound fractures and after operations when no previous open wound was present, or if they could have indicated what Sir James Paget tersely called the "well-doing or the ill-doing of each patient." The way

[1] During the years 1876, 1877 and 1878 the total number of cases of injury was 2862 and of operation 1235. Amongst them there were:

6	cases of	pyaemia	after	injury	with 6	deaths.
11	,,	,,	,,	operation	,, 10	,,
22	,,	erysipelas	,,	injury	,, 4	,,
38	,,	,,	,,	operation	,, 8	,,
28	,,	blood poisoning	,,	injury	,, 10	,,
49	,,	,,	,,	operation	,, 18	,,

Brit. Med. Journ. 1879, vol. ii. p. 212.

would have been cleared by honest answers to such questions as these: Have you succeeded in absolutely abolishing pyaemia and erysipelas from your wards? Is your confidence in the means of preventing these diseases sufficient to enable you, with a clear conscience, to do such operations as, say, sawing across and straightening a fractured femur that has been badly set? For it must be remembered that Savory would not have thought of undertaking many of the operations which Lister had long since shown might safely be performed in the unhealthy wards at Glasgow and the moderately healthy wards at Edinburgh. But the ordinary bald statistics of mortality after amputations would have confused the issue and have been worse than useless.

Savory's address is still spoken of as the swan-song of the already dwindling race of pre-antiseptic surgeons. It expressed, however, the views of a considerable proportion of the senior members of the staffs of the London and provincial hospitals at the time. Like a poultice, it warmed and comforted the soul of many a middle-aged man, who had begun to feel the discomforts of an undermined faith; though it almost made some of the younger men, to whom time passes but slowly, despair of the future.

Later in the same year, December 1879, an influential meeting of the South London Division of the Metropolitan Counties Branch of the British Medical Association was held at St. Thomas's Hospital to discuss antiseptics. In the course of the debate [1] Lister referred especially to Savory's address in these words:

"Well, Sir, I have been often reproached for not having published statistics, and it has been hinted, and the hint has been lately prominently repeated, that I have suppressed statistics because I had none which I should not be ashamed to produce. Sir, the truth is that life is short, and that when every day begins one has to consider which is the occupation that is most likely to be valuable; and feeling, as I do, very much as Mr. Macnamara does with regard to statistics, I have felt that there was every day something both more congenial and, I hoped, more profitable to do than to compile statistics."

[1] See *Antiseptic Surgery*, by William MacCormac. London, Smith, Elder & Co. 1880, p. 61.

He added that he was not fairly open to the charge of having withheld statistics with regard to the question of hospital diseases, as he had published some when he left Glasgow, and others in 1875. He then proceeded to analyse some recently compiled for him by Watson Cheyne and to show how misleading statistics are and how easy it is, almost unconsciously, to manipulate them in favour of a point it is desired to prove.

How far the faith of the seniors was undermined and how far they were yielding to the force of circumstances may be gathered from this debate at St. Thomas's Hospital, which extended over two nights and, though not a brilliant performance, was by far the most serious discussion of the subject that had taken place in London.

Two more passages from Lister's speech must be given. Speaking of the new facts he had proved, he said :

"If these matters have not attracted attention, it cannot be because they are not worthy of it; I presume it is because I have not the capacity to bring them before my professional brethren with sufficient force to impress them upon them. It is not, I say, that these things are unimportant; but that they are not believed." And this was his peroration : "I feel I owe an apology to the meeting for having detained it so long, and I return you my sincere thanks for having listened to me so patiently. In such a gathering of medical men as I see before me I cannot avoid speaking warmly on a matter so near my heart. I have been charged with enthusiasm; but I regard enthusiasm with reference to the avoidance of death, pain, and calamity to our fellow-creatures as a thing not at all to be ashamed of; for I feel this to be a matter of which I may say in the words of Horace :—

> Aeque pauperibus prodest, locupletibus aeque,
> Aeque neglectum pueris senibusque nocebit."

This debate also clearly showed how the often unconscious adoption of portions of Lister's practice interfered with the acceptance of the doctrine as a whole. From the very first the antiseptic leaven began to work and led to a general diminution of hospital diseases, which was forthwith attributed entirely to improvements in hospital hygiene. And yet, though this was the favourite view to hold and to express, one surgeon after another made attempts to obtain results equal to Lister's by simpler, or what were thought to be simpler,

means. One satisfied his conscience by merely substituting oakum for lint as a dressing, another by applying weak solutions of iodine to his wounds. Callender of St. Bartholomew's had a system of his own which Lister described as "a thorough antiseptic treatment," and Jonathan Hutchinson of the London Hospital kept his dressings constantly soaked with spirit of wine and lead lotion. Both Callender and Hutchinson obtained good results. So did Croft and MacCormac, who followed Lister's practice implicitly, though not with complete success, in the fine new St. Thomas's Hospital —the first up to date pavilion hospital in London.

But almost the only two London surgeons who in early days carried out the treatment thoroughly and efficiently in hospital practice were Howse of Guy's and Marcus Beck of University College. Beck thus describes the situation in a letter to Lister, February 21st, 1876:

"It is very good of you to remember the spray. My private operations are so few and far between that I need hardly think of them, especially as I have a small hand spray that does very well. On the other hand, I can scarcely ever operate at the hospital without being bothered by inefficient sprays. As you kindly offer me my choice I think I should prefer a hospital spray. I often feel sorry that I am unable to do more to make myself known as a believer in antiseptic surgery in London. I have in the first place but little opportunity of practising it—as I seldom get charge of in-patients. In the next place I am a perfect fool at speaking at societies and at writing. [A complete mistake; he was remarkable as a teacher and a clear writer.] I have begun several things on the use of antiseptics, but somehow I never get them in a state to publish. I have to work for my living at so many other things that I am constantly interrupted in any work of my own. . . . It is a very thankless task to try to preach antiseptics to a London audience. It wants a man of far greater debating power than I have to do it successfully. Only the other day my old enemy Howse of Guy's (who beat me for the scholarship in Surgery) brought forward a splendid case of an antiseptic operation for intussusception on an adult before the Medico-Chirurgical Society, but made no special allusion to the antiseptic treatment. I asked him afterwards why he did not, and his reply was, 'Oh, it is no use here'—and I really think he was right. He is full surgeon now at Guy's and is a most firm believer in antiseptic surgery, and will I have no doubt do much towards increasing its use."

To these two names one more must be added—that of Knowsley Thornton, who took up the study of medicine because on a visit to Edinburgh he was deeply impressed with Lister's personality, and who became his "almost perfect house surgeon," and later his strong supporter and friend. On Lister's recommendation he left a rough country district in the wilds of Northumberland and came to London to help Spencer Wells in his large and fashionable practice. Wells, as we have seen, had recognized the importance of the germ theory even before Lister; and now with Thornton's assistance carried out the antiseptic treatment in every detail. Thornton in time gained a very wide reputation as an operator both in private practice and at the Samaritan Hospital. A clear writer, a good debater and a keen fighter, he did much to familiarize both the profession and the public with Lister's work. But as his own field was chiefly abdominal, he was less convincing than if he had been a general surgeon.

As time went on, and Lister's teaching came back to England refurbished from Germany, it was accepted almost as a novelty, with all its foreign accretions, good and bad. The marble theatres, the glittering nickel-plated drums of dressings, the roar of the steam sterilizers, the white linen robes, and hand washing timed to the fall of sand in an hour-glass, were like the trappings of a gorgeous ritual as compared with the mere shining of the inward light. Nurses, dressers, and even the surgeons themselves became impressed with the importance of being always on guard, and with the fact that there was indeed something to guard against. Thus, by degrees, good habits were acquired, with a consequent improvement in results; and then the old slovenly ways came to be looked upon with disgust and were finally almost forgotten. But it was a slow process, and long after Lister came to London it was hard to find a dozen surgeons in the metropolis who were really competent to carry out the antiseptic treatment of a serious case.

If things moved slowly in London, it was not quite the same in the country, probably because in the larger provincial

towns young men were more frequently advanced to the charge of wards. This was most marked in the North and in the Midlands, where hospital appointments often fell to Scottish graduates, who had come under Lister's direct influence. Amongst these younger men Mitchell Banks of Liverpool, who was a Glasgow student in 1865, deserves special mention. Working on antiseptic lines, he did much to enlarge the field of surgery. A certain number of Lister's contemporaries in the provinces were also amongst his most active supporters.

Bickersteth of Liverpool, writing to Syme in 1869, said: "I am a firm disciple in the antiseptic theories and practice," and, after describing his successes with the catgut ligature, "I am lost in wonder and admiration at this great discovery."

Oliver Pemberton of Birmingham, well known as a surgeon and as a remarkable personality, who had made Lister's acquaintance at Edinburgh in 1856, wrote thus to him many years afterwards: "I know you have caused more lives to be saved in the hospitals of Europe than ever yet were saved by surgery. Absolutely saved. Think over this statement—made by one who has been a hospital surgeon for five and thirty years, and let it make your sleep sweeter if that be needed." [1]

Lund of Manchester, who of all English provincial surgeons followed Lister most exactly and succeeded in obtaining excellent results, wrote at the same time: "You know how I have watched your progress for so many years and you are aware how I have sympathized with you in all the difficulties you have had to contend with in enunciating new doctrines which were either decried or misunderstood, from motives too apparent to be concealed."

And Cadge of Norwich, Lister's fellow student in London and the foremost surgeon of his day in the Eastern Counties, said: "It has been oftentimes a real pleasure to me to watch the signs of your growing fame, growing always and steadily in spite of not a little opposition and envy. I may be wrong but it has always seemed to me that your work and reputation

[1] This and the two following letters were written in December 1883.

have been more fully recognised and admitted in all other countries than this."

If we now turn to Scotland we find that in Edinburgh, while Lister was still professor there, he had no support from his colleagues on the senior staff, but that there were firm adherents amongst the juniors. After he left, John Chiene and John Duncan did their best to keep the flag flying amidst many difficulties.

In Glasgow all the surgeons at the Royal Infirmary, except one, affected to "give the new treatment a trial," but, according to unimpeachable evidence, "the thing was a sham." In 1874 Hector Cameron became one of the surgeons; he was thoroughly versed in Lister's methods and obtained equally good results. For long his was the only other clinic in the British Isles, except perhaps Lund's, of which this could truthfully be said. In 1877 Macewen [1] joined the full staff. He was very successful from the first, but he worked more on the modified German than on the original Listerian lines. The fine Western Infirmary was opened in 1874, and was staffed by three surgeons, each of whom professed to use the antiseptic method, but none of them were able to produce aseptic results. Thus Glasgow, like Edinburgh, had to wait for the advent of the new generation.

Further north, at Aberdeen, Ogston,[2] who is still an ornament to his profession, grasped the idea as a young man, and, having no deep-rooted prejudices to overcome, worked at the subject bacteriologically and practically, and made many consequent improvements in the art of surgery. In 1883 he wrote to Lister: "You have changed Surgery, especially operative surgery, from being a hazardous lottery into a safe and soundly-based science, you are the leader of the modern generation of scientific surgeons, and every wise and good man in our profession—especially in Scotland—looks up to you with such respect and attachment as few men receive."

Little need be said about the reception of Lister's teaching in Ireland. It excited neither great enthusiasm nor active

[1] Now Sir William Macewen. [2] Now Sir Alexander Ogston.

opposition. In Dublin and Belfast, the two principal surgical centres, leading surgeons, with a few notable exceptions, either smiled at the innovation or ignored it.

After listening to the opinions of all these active hospital surgeons, let us hear the words of Huxley, who, though not unfamiliar with practice, was essentially a follower of pure science. In his Presidential Address at the Liverpool meeting of the British Association in 1870 [1] he said:

"I refer for this evidence to the very striking facts adduced by Professor Lister in his various well known publications on the antiseptic method of treatment. It seems to me impossible to rise from the perusal of those publications without a strong conviction that the lamentable mortality which so frequently dogs the footsteps of the most skilful operator, and those deadly consequences of wounds and injuries which seem to haunt the very walls of great hospitals, and are, even now, destroying more men than die of bullet or bayonet, are due to the importation of minute organisms into wounds, and their increase and multiplication; and that the surgeon who saves most lives will be he who best works out the practical consequences of the hypothesis of Redi." [2]

It is the fashion to criticize Lister's fellow-countrymen somewhat severely for their tardiness in recognizing the importance of his teaching. Some explanation has already been given; it is only fair to admit that there was also some excuse for their attitude towards it. Paradoxical though it may sound, this is supplied by the general improvement in hospital hygiene, which was due in great measure to the untiring energy of Florence Nightingale. The results of her labours were shown not only by the creation of the modern system of nursing, but by the erection—for all the world to see—of the great Herbert Hospital at Woolwich (1860-64), the first pavilion hospital in this country. It was followed (1865-71) by the palatial new St. Thomas's on the Thames

[1] See *Nature*, 1870, vol. ii. p. 400.

[2] Francesco Redi (1626-1698), a brilliant Florentine poet, author of *Bacco in Toscana*. He was also Court physician. He made the first step in the scientific refutation of the theory of spontaneous generation, by proving that no maggots were "bred" in meat on which flies were prevented by wire screens from laying their eggs.

Embankment, which was equally admired for its beauty and condemned for its extravagance. Soon more hospitals of the same type appeared in other parts of the country, and there can be no doubt that much good was done by the forcible turning of the mind of the profession upon isolation, ventilation, cleanliness and the avoidance of overcrowding. In all this the powerful influence of Simpson must not be forgotten; nor, for the matter of that, the influence of Lister himself. Thus, for those who did not enquire too closely or reason logically, there was some excuse for doubting whether the diminution of hospital diseases was due to improved hospital hygiene or to the antiseptic system of treatment. The excuse was a bad one, because private practice was left out of account, and because it would not explain what Lister had effected before these improvements had taken place in Glasgow and in Edinburgh. Nevertheless, we, in these enlightened days, must not judge harshly those who lived in the period of transition.

Lister, at the time, found it hard to understand the indifference of his fellow-countrymen. Referring to the "flask experiment" in the Plymouth address, he says: "I confess, Mr. President, I am ready to blush for the character of our profession for scientific accuracy when I see the loose comments sometimes made upon this experiment; and I am tempted to doubt whether some of the commentators can have enjoyed the advantages of sufficient education either in chemical physics or in logic." And again, after pointing out that his own successes were amply confirmed by some obtained abroad and some in the Naval Hospital at Plymouth, he adds: "After statements of this conclusive character have been published regarding what is generally admitted to be the most urgent medical question of the day, when I consider the apathy with which they have been received in many quarters, I cannot avoid being reminded of the language of Macbeth:

> Can such things be,
> And overcome us like a summer's cloud,
> Without our special wonder?" [1]

[1] *Collected Papers*, vol. ii. p. 175 and p. 197.

CHAPTER XXI

RECEPTION OF LISTER'S TEACHING ABROAD

THE German system of medical education in the middle, indeed before the middle, of the nineteenth century, was fundamentally different from—shall we say superior to?—the English. Clinical instruction in Germany formed a regular part of University training. The Professors of Medicine and Surgery lectured in the University, and the University hospitals provided them with their fields for practical instruction and research. The hospitals were, in fact, for them, what the dissecting rooms, post-mortem rooms and laboratories were for the Professors of Anatomy, Pathology, Physiology, Biology, Chemistry and Physics.

In England doctors learned their clinical medicine and surgery by serving as apprentices and by "walking the hospitals." They had no need to look to the right hand nor to the left; their one aim was to obtain a license to practice. But in Germany they, for the most part, took a University degree, and were all educated in a University atmosphere, a privilege which it may be as easy to ridicule as to overrate.

If we put the beginning of the German scientific era at 1825 and allow that it took some twenty years for the German system of scientific education to mature, it will be seen that in 1865-70, most of the middle-aged, and some of the older German surgeons had approached their life's work with a very different outlook from that of their English *confrères*. For it must be remembered that, in this country, even then, that is long after the student days of the middle-aged and older English surgeons alive at the time, the Universities of Oxford and Cambridge exercised very little influence on medical

education, that the University of Edinburgh was the only one in the British Isles in which anything at all comparable to the German system existed, while in London a University, properly speaking, did not exist at all.

In London, University College was the only large school where a medical student was educated side by side with students of other faculties; where he could breathe a sort of University atmosphere, and might, if he liked, obtain a real scientific education in physiology, biology, chemistry and physics. Even at University College there was little of the true University spirit, for the "medicals" and the "arts men"—science and laws hardly counted—treated one another with a certain aloofness and mutual suspicion.

King's College followed the same lines as University College, but it was a much less important school than it afterwards became. The other London schools made no attempt at anything approaching to a University training. Their teaching of the early scientific subjects was of a rudimentary nature, just sufficient to enable the students to "scrape through the Colleges," that is, to obtain the diplomas of the Royal Colleges of Physicians and of Surgeons and that of the Apothecaries' Hall, through which portals the large majority of the general practitioners and surgeons made their entry into the medical profession. It is not suggested that the average British doctor was, or is, less efficient than the German; indeed, the opposite is probably true; but it may be stated without fear of contradiction that the average English hospital surgeon was not a highly educated man, and that the average German hospital surgeon was better fitted to appreciate and to practise a new method of treatment, based, as was the antiseptic system, upon a somewhat abstruse scientific foundation.

In 1867 there were 64 surgeons and assistant surgeons attached to the eleven great London hospitals with medical schools. Of these only 7 had medical degrees, and these only of the University of London. One was B.A. London and two were B.A. Cantab. How different from the present day (1916) when out of 87 surgeons and assistant surgeons only 18 are not graduates and these are mostly seniors who will before long automatically disappear. A degree, of course,

is nothing ; it is the training which leads up to the degree that is of value, and it is satisfactory to think that in the coming years the possession of some proof of University training will be considered a *sine quâ non* for any surgical appointment at the chief London hospitals.

Though the German system may possibly turn out better trained men, that is, with more book-knowledge in their heads, and better equipped to think out a scientific problem, it is generally allowed that they are, at the end of their prolonged studentship, less practical doctors than those which our more happy-go-lucky English system produces.

In those days they were in many ways far behind us, especially in the matter of sanitation. Not that the Germans were in this respect worse than their neighbours ; but in England both domestic and public sanitary reform set in earlier than on the continent. Those who are old enough to remember holidays abroad thirty or forty years ago will agree that the edge of the enjoyment was taken off by the primitive arrangements at even the best hotels. These only showed the accepted standard of *domestic* cleanliness on the continent, and it is therefore not surprising that still worse conditions were met with in their enormous hospitals. After all, sanitary science is of recent growth, and England was only a few years in advance of her neighbours. There was, as we have seen, much room for improvement in our own hospitals in spite of all that had followed the lessons of the Crimean war and the efforts of Florence Nightingale ; but they were spoken of abroad as models of healthiness.[1] Thus our continental brethren were more urgently in need of Lister's teaching and more impressed with the extraordinary changes it produced.

It is easy to understand that, although this teaching appealed more to the German than to the English mind, and although German surgeons discussed the principle involved in a rational way even if they disagreed with it, and at first adopted the

[1] "Fornitì come sono d' ospedali modello dove, oltre alla massima pulizia, sono curate tutte le regole dell' igiene, non trascurando tutti i commodi della vita."—*Alcuni esperimenti sulla medicatura alla Lister.* Giuseppi Ruggi di Bologna, *Commentario Clinico di Pisa.* Anno II. nn. 1-2.

treatment with enthusiasm, nevertheless, when it came to carrying out the essential details, comparatively few of them were able to overcome their old slovenly habits, and the majority failed to obtain the promised results. The success of the few was, however, too remarkable to be ignored. But the general enthusiasm waned and in some places gave place to actual opposition.[1]

Thiersch of Leipzig was the first German surgeon of note to adopt the antiseptic treatment. He began as early as 1867 and continued to practise it to the end of his long and distinguished career. Lister refers to him in a letter to his father, February 23rd, 1868:

"I also send two pamphlets I received last week.... The German one, a thesis for the doctorate by a young man who has been a House Surgeon in a Leipzig hospital, gives an account of 16 cases in which he has used my plan with abscess: and with entire success.[2] Thee will not wade through the reports of the cases in small print, but some parts of the large print will I think amuse and please thee. The pamphlet was sent by Professor Thiersch, the surgeon under whom the young man was House Surgeon in the hospital. He also sent me at the same time some articles of his own (Thiersch's); and among these is one on the healing of wounds, in which he gives me full credit for the antiseptic system, though alluding to the hostile criticisms."

The young man was Dr. Hermann Georg Joseph, and as the thesis was read on December 21st, 1867, it is clear that no time was lost at Leipzig. Dr. Joseph's must have been one of the earliest German publications on antiseptics. It is sad to think that, as Thiersch said in 1875, a stern frost fell upon the early effort of the youthful author (ein rauher Frost legte sich auf die frischen Triebe des jugendlichen Autors).

At the time Thiersch wrote these words he had completely abolished hospital gangrene from his large clinic (300 beds) in the Jacob's Hospital, and there had been only one case of pyaemia in twelve months. His results, though always good, and constantly improving as he gained experience, did not

[1] A. W. Schultze, Volkmanns Samml. Klin. Vort., 1872, No. 52 (*Chirurgie*, No, 17), pp. 333-358.

[2] *Joseph Lister's Antiseptische Behandlung der Abscesse*, Hermann Georg Joseph. Leipzig, Otto Wigand, 1867.

equal those of some other German surgeons. Possibly this was partly due to the fact that he worked principally with salicylic acid, the antiseptic properties of which had been discovered by Kolbe, a Leipzig professor. It is a very useful substance, though it has its limitations. Lister gave it a thorough trial and continued to use it in one form or another throughout his practice. He first heard of it in 1874, and wrote thus to his brother on August 7th of that year:

"I am dreadfully busy with a wonderful new antiseptic, salicylic acid, the antiseptic properties of which have been discovered by Professor Kolbe of Leipzig.

It is only very slightly soluble in cold water, requiring 800 parts at 65° F. to dissolve it; yet this small quantity of the acid entirely prevents the fermentation of grape sugar solution mixed with yeast, and also entirely prevents putrefaction. Very curiously it prevents the evolution of hydrocyanic acid and oil of bitter almonds from the bitter almond, if the solution of the acid is used instead of water to crush the almond in. In other words it prevents purely *chemical* fermentations so-called. Now the question comes, does it ALSO *kill the organisms*? Torulae or bacteria? This is what I am working at. It is a most important question: for if it does *not* kill the organisms but merely prevents them, while it is present, from effecting chemical changes, then it will be only useful for superficial wounds or sores. But more of this another day."

On the occasion of Thiersch's seventieth birthday, Lister wrote to congratulate him and received the following reply: [1]

"LEIPZIG, 7. *Juni* 1892.

MEIN SEHR VEREHRTER PROFESSOR LISTER!

Ihre guten wünsche zu meinem leider 70 Geburtstag sind für mich besonders ehrenvoll, denn sie kommen von einem Manne, dessen stern am chirurgischen himmel leuchten wird, so lang es überhaupt eine chirurgie giebt. Sie wissen, dass ich zu Ihren ältesten und eifrigsten Anhängern gehöre, und die 25 jahre seit dem Sie Ihre reform in's Werk gesetzt, haben meine Verehrung noch gesteigert, da ich täglich sehe, was unsere Kunst in folge Ihrer reform zu leisten vermag.

Mögen Sie sich noch viele jahre an dem segen erfreuen, den die arbeit Ihres lebens der menscheit gebracht, und bewahren Sie mir das

[1] The peculiar omission of capital letters is Thiersch's own.

freundschaftliche interesse und das wohlwollen, welches aus Ihren zeilen spricht.

Ihr ergebenster,

CARL THIERSCH."[1]

Lister's most powerful advocate in Germany was Richard von Volkmann, an intimate friend of Thiersch. He had just been appointed Professor of Surgery at Halle in 1867 when Lister's first publications appeared. He was an attractive, impetuous man, of classical and artistic tastes, and more than an amateur poet. He wrote with a fine literary style, and rather welcomed than avoided a conflict. For twenty years he was one of the most prominent and original of German surgeons, so that surgeons visiting Germany seldom failed to see his clinic at Halle.

His predecessor Blasius had reached an advanced age. The hospital was very old and frightfully unhealthy. Even small operations meant certain death. So that for a full quarter of a year no one dared to touch a knife in the surgical clinic. ("So dass man ein volles Vierteljahr überhaupt nicht wagte in der chirurgische Klinik das Messer anzurühren.")[2]

Fresh from his experiences in the Prusso-Austrian war of 1866, Volkmann introduced the "open treatment," and by this means greatly diminished the mortality. Then came the Franco-German war of 1870. After eight months at Sedan and Paris, he returned to find the hospital crowded with wounded soldiers and in a hopelessly infected state; the hygienic condition indescribably worse ("in einer unbeschreiblichen Weise verschlechtert"). Pyaemia and erysipelas carried off the majority of the patients after serious operations.

[1] "MY MUCH HONOURED PROFESSOR LISTER,

Your good wishes for my, alas 70th birthday are an especial honour for me, because they come from a man whose star will shine in the surgical heaven, as long as surgery exists. You know that I am one of your oldest and most zealous followers, and the 25 years since you instituted your reform have increased my respect because I see daily what our art may achieve as a result of your reform.

May you for many more years rejoice over the blessing your life's work has brought to mankind; and please maintain that kindly interest and good will towards myself which the words of your letter express.

Your most devoted

CARL THIERSCH."

[2] Fedor Krause, *Richard Volkmann*. Berlin, August Hirschwald, 1890.

All his efforts to improve matters were now unavailing, and by the winter of 1871-72 he thought of closing the hospital. In November 1872 he decided to give Lister's treatment a trial, after thoroughly mastering its details, though without visiting Edinburgh either personally or vicariously. He did so "with the settled opinion," as he himself said, "that it was only a question of a few weeks' fruitless (vergebenes) experiment, and only from the point of view of a laborious but unavoidable duty." The result was magical. He said that operative surgery was revolutionized; he became henceforward "Lister's most devoted disciple" (treuester Jünger) as Krause called him, adding in rather highflown words that Volkmann's name would always stand by Lister's as one "welcher die neue heilbringende Wahrheit durch schwere Kämpfe und Anfechtungen zum endlichen glänzenden Siege muthig hindurchgeführt hat." [1]

Pyaemia was completely, and erysipelas almost completely, banished from his wards. In referring to this he said at the third congress of German surgeons in 1874: "There is no luck in surgery, as Pirogoff says there is. There are no privileged surgeons who always hold good cards. Knowledge and ability are the only factors that command success. For every case of pyaemia, for every case of erysipelas, for every death from diffuse suppuration (Eitersenkung) the surgeon himself is responsible."

Volkmann was certainly a doughty champion. He extended the field of application of the antiseptic treatment by inventing new operations which no one had dared to do without the protection it provided. Lister was for him his "much honoured friend and teacher to whom he is more thankful than to any other." He was one of the most striking figures at the International Medical Congress in London in 1881, but soon afterwards his active work was cut short by serious illness. Not long before his death on January 2nd, 1889, he wrote to Lister describing the dreary months spent in a sanatorium, and ends thus:

"Leider ist es mir in Folge dessen auch nicht möglich gewesen meinen sehnlichsten Wunsch zu erfüllen und England zu besuchen um mich

[1] "Who has courageously carried the new health-bringing truth through severe battles and contests to a final brilliant victory."

bei meinen Gönnern und Freunden persönlich für all die Anerkennung und all die Liebenswürdigkeiten zu bedanken, die ich von ihnen empfangen habe. Aber: wie ein deutscher Dichter sagt, der Mensch hofft so lange, wie er lebt, und so mag ich mich auch noch nicht des Gedankens zu begeben, Ihnen noch ein Mal in London die Hand zu drücken. . . .

Gott schenke Ihnen und Ihren verehrten Frau Gemalin ein reiches und gesegnetes Neues Jahr.

Ihr dankbar ergebener

RICHARD VON VOLKMANN.[1]

The names of Thiersch and Volkmann naturally recall that of Stromeyer of Hanover, with whose work in connection with subcutaneous surgery we are already familiar.[2] He was eighteen years older than Thiersch, who had served under him in the Schleswig-Holstein war and had learnt from him the value of the open treatment. The fact that the antiseptic system was the successful rival of both the open treatment and subcutaneous surgery did not prevent Stromeyer from welcoming it. He crystallized his opinion in some light verses which, with his smiling photograph, dated August 1, 1875, was sent to Volkmann and somehow came into Lister's possession.

LISTER.

Mit Staunen sieht die Welt es an,
Was Lister, Du für uns gethan.
Vernichtet ist des Todes Macht,
Wo Deine Antiseptik wacht.

Die Krone der Unsterblichkeit
Hat Dir Germania geweiht,
Und ruhmvoll Dir zur Seite steht
Jetzt Richard Volkman—Dein Prophet.

[1] "Unfortunately, as a result of this, I have not been able to gratify my fondest wish and come to England, in order to thank my well-wishers and friends personally in their own home for all the recognition and friendliness I have received from them. But as a German poet says, Man hopes as long as he lives, and so I cannot yet give up the thought of once more pressing your hand in London.

God grant you and your honoured wife a rich and blessed new year.

Your grateful and devoted

RICHARD VON VOLKMANN."

[2] Page 155.

He must have known its destination for he supplied his own English translation :

LISTER.

Mankind looks gratefull now on Thee
For what Thou didst in Surgery.
And Death must often go amiss,
By smelling antiseptik bliss.

By Volkmann's skill and industry
Famous Thou art in Germany !
Who could a better Prophet be,
Than Richard Hotspur was to Thee ?

Meanwhile the " open treatment," which was still being actively carried out at Berlin, Zurich and elsewhere, found a warm supporter in a young surgeon, Dr. Krönlein, who tried to prove by the analysis of statistics,[1] with typically German minuteness, that it was at least as good or even better than the antiseptic system,[2] and threw doubts upon the honesty of Volkmann's statistics. Volkmann fell upon him in a rather brutal manner, and he almost as hotly replied.[3] These wordy and personal polemics on the whole served to attract attention to Volkmann's remarkable achievements.

The story of the Munich hospital has often been told. It was one of the most unhealthy of all the large German hospitals. Pyaemia and erysipelas were rampant, and in 1872 hospital gangrene became so firmly established, that it affected no less than 80 per cent. of all wounds, whether accidental or inflicted by the surgeon, and the mortality was so great that the closing of the hospital was contemplated. Professor von Nussbaum thus described in 1875 the effect of the adoption of the antiseptic treatment :

" Everything that we had tried against the above-mentioned horrors had proved unsuccessful. The open treatment, the occlusion

[1] R. U. Krönlein, *Beiträge zur Geschichte und Statistik der offenen und antiseptischen Wundbehandlung.* Zurich, 1872 und Berlin, A. Hirschwald, 1875.

[2] R. Volkmann, *Herr Dr. R. U. Krönlein und seine Statistik.* Leipzig 1875.

[3] R. U. Krönlein, *Offene und antiseptische Wundbehandlung. Eine sachliche Entgegnung auf persönliche Angriffe.* Berlin, A. Hirschwald, 1876.

dressing, the continuous water-bath, irrigation with chlorine water or with carbolic-acid solutions, salicylic acid in powder and in solution, the putting on of Lister's antiseptic materials—carbolic paste, &c.—all, all were unable to combat hospital gangrene and pyaemia. But when in the course of a single week, with great energy and industry, we applied to all our patients the newest antiseptic method, now in many respects improved by Lister, and did all operations according to his directions, we experienced one surprise after another. Everything went well; not a single other case of hospital gangrene occurred. Pyaemia and erysipelas were observed a few times at the very beginning; but only, as the result proved, because we did not yet possess the necessary practice in the carrying out of Lister's directions. We took pains, as you know, and learned from day to day more exactly how to comply with his instructions. Our results became better and better, the time of healing shorter, and pyaemia and erysipelas completely disappeared."[1]

Like that of Volkmann the conversion of Nussbaum was sudden and permanent. He also wielded a ready and graphic pen, as may be seen from this passage in the fifth edition of his *Leitfaden zur Antiseptischen Wundbehandlung*, which in 1877 had been translated into five foreign languages:

"Ten years ago many distinguished surgeons called Lister's treatment humbug (einen Humbug), and considered it an unpardonable attack upon surgical freedom to assert that no surgeon has any right to be ignorant of the antiseptic treatment.

In 1880 I said in a clinical lecture that in medico-legal cases a surgeon could be called to account if he completely ignored antiseptics and lost a patient from pyaemia.

For this I was reproached in the most violent manner both verbally and in print. A distinguished medical-jurist (Gerichtsarzt) wrote a letter about me in which he called me a fanatic, and said that no medical-jurist alive would reproach a practical surgeon who had acted faithfully according to the teaching of the text books recommended at the University, because a practical surgeon could neither buy all new books, nor ought he to allow his principles to be shaken by every new discovery.

Ten years have not yet passed, and the evidence in favour of the value of the antiseptic treatment has increased a thousandfold, so that such contests between educated surgeons are no longer possible."

[1] *Collected Papers*, vol. ii. p. 249. J. N. v. Nussbaum, *Die chirurgische Klinik zu München im Jahre* 1875: *ein Andenken für seine Schüler*. Stuttgart, Ferdinand Enke, 1875.

His writings are full of striking passages, as when he observes that "naturally antiseptics do not confer immortality," or in his introduction to the discussion of the use of antiseptics in war, where he describes how in 1870 he prepared eight solid wooden boxes for his favourite instruments (Lieblingsinstrumente), but never saw them again and had to perform 600 operations with two or three essential ones which he had stowed away in the left pistol pocket of his saddle.

Several of Nussbaum's letters to Lister are preserved, of which the following is a good example, and not without historical interest.

"MÜNCHEN 22. Mai. 1881.

HOCHVEREHRTESTER HERR COLLEGE UND FREUND!

In 6 Jahren hat mein kleines Buch nun 4 Auflagen erlebt und eine Uebersetzung in die griechische, zwei Uebersetzungen in die französische und zwei in die italienische Sprache. Das ist gewiss ein Beweis dass sich die Lister'sche Methode auf der ganzen Welt Bahn bricht, worüber Herr College eine grosse Freude empfinden müssen, denn ich halte Ihre Erfindung nach der Chloroform-Narcose für die grösste und segenreichste in unserer Wissenschaft.

Gott lohne Sie dafür und lasse Sie lange und glücklich leben zur Freude Ihrer Verehrer, wozu sich zu rechnen erlaubt

Ihr

dankbarer College und Freund
Proff. Dr. J. RITTER VON NUSSBAUM.
k.b. Generalstabarzt." [1]

They were often quaintly expressed.

"MÜNCHEN, 12 Sep. 1889.

MY DEAR SIR,

Alle Tage denke ich mit Dankbarkeit und Liebe an Sir Lister. Heute schicke ich Ihnen meinen ersten Assistenten und

[1] "MOST HIGHLY ESTEEMED COLLEAGUE AND FRIEND,

My little book has now gone through 4 editions in 6 years and has been translated once into Greek, twice into French and twice into Italian. That is clearly a proof that the Listerian method is making way over the whole world, on which account my Colleague must feel great joy, for I hold that next to that of chloroform-narcosis your discovery is the greatest and most blessed in our Science.

God reward you for it, and grant you a long and happy life to rejoice your admirers, amongst whom claims to be included

Your

Grateful Colleague and friend,
PROF. DR. J. RITTER VON NUSSBAUM,
k.b. Generalstabarzt."

jungen Freund: Dr. Fehrler. Er ist ein vortrefflicher Antiseptiker und guter Bacteriolog.

Empfangen Sie meine Huldigung und meinen täglich ausgesprochenen Dank.

Ich bleibe Ihr
bewundernder
Apostel
GEHEIMRAT VON NUSSBAUM.

P.S.—Dr. Lindpaintner geht es gut." [1]

Turning from the provinces to Berlin, we find the veteran von Langenbeck preserving a benevolent neutrality. He did not give the treatment a trial before Lister's visit to Germany, on what may be called a tour of inspection, in 1875.[2]

Another well-known surgeon, von Bardeleben, however, began to make his first attempts with Lister's dressings in the notoriously unhealthy Charité Hospital, in the early part of 1872. They gave such remarkably good results, that he felt it his duty to apply them to all serious wounds.[3] His supply of dressings was exhausted in a few days. So he improvised a dressing of ordinary clean "mull" soaked for a few hours in a strong watery solution of carbolic acid, then dried and kept till wanted in a weak solution of carbolic acid. This satisfied him; he evidently thought highly of this moist dressing, and said that some of his patients preferred what he called the "feuchter Lister." But Lister, when he saw his practice, said: "I feel bound to express my conviction that Professor Bardeleben would get still better results had he not been led, on the score of economy, to substitute for our antiseptic gauze

[1] "MY DEAR SIR,

Every day I think of Sir Lister with thankfulness and love. I am now sending you my chief Assistant and young friend Dr. Fehrler. He is an excellent antiseptician and a good bacteriologist.

Accept my homage and my daily expressed thanks.

I remain your
admiring
Apostle
GEHEIMRATH VON NUSSBAUM.

P.S.—Dr. Lindpaintner is doing well."

[2] *Collected Papers*, vol. ii. p. 252.

[3] Adolf Bardeleben, *Ueber die Theorie der Wunden, &c.* Berlin, A. Hirschwald, 1878.

unprepared gauze soaked with a watery solution of carbolic acid." [1]

This was also the opinion of Bardeleben's former assistant, A. W. Schultze, who, in a valuable paper,[2] describes how he went to Edinburgh in 1874 as a doubter, and only desirous of seeing for himself before forming his final opinion. He spent four weeks there, making daily visits to the Infirmary. He comments on its formless, straggling, ancient buildings, packed away amongst the smoke-grimed houses of the dingy old town and far inferior to many other hospitals he had seen in the United Kingdom. He noted the poverty-stricken appearance of the wards, the open windows and the open fires, and the fact that the patients, so unlike the Germans, did not complain of the cold draughts of a chilly November; which was attributable, he thought, to the insensibility of Englishmen, or their prejudice in favour of this method of heating. But what he saw convinced him, and he came back a firm believer.

The importance of Schultze's paper for our present purpose is the clear statement it contained that by 1875 the early enthusiasm in Germany had cooled because surgeons could not succeed in obtaining Lister's results, so that in some places actual opposition had set in. It is also interesting because the author visited many others of our British schools and with a light appreciative touch, hits off what he saw. For example, he says that " in London Lister has few adherents. The principal surgeons have nothing to do with it, because they say they do not obtain from it any better results, and, speaking generally, the whole affair is too complicated for them. Precise objections you do not hear; the details of the practice are usually unknown to them."

Not less instructive was his round of the continental schools. It was the same story in Holland, Belgium, South-Germany and Vienna. He never saw the treatment properly carried out. It had been tried and given up. No rational

[1] *Collected Papers*, vol. ii. p. 252.

[2] A. W. Schultze, *Ueber Lister's antiseptische Wundbehandlung nach persönlichen Erfahrungen*, 1872. Volkmann's Samml. klin. Vortr. No. 52 (*Chirurgie*, No. 17), pp. 333-358.

objections were offered. For the most part surgeons were content to clap carbolic acid dressings on to wounds and suppurating surfaces, and looked upon Lister's publications with distrust.

Amongst the many Berlin surgeons, one other must be mentioned, Ernst von Bergmann, well known to Englishmen in connection with the illness of the Emperor Frederick. Destined first for the church and afterwards for philology or law, he became, as it were accidentally, a surgeon. He might have shone in either of the other professions, for, if he had a weakness, it was allowing himself to be carried away by the flood of his own eloquence. When about thirty years of age, he thought of devoting himself to scientific medicine. But, during the Franco-German war, he foresaw that the field of practical surgery was sure to be indefinitely widened by the introduction of the antiseptic system, and would thus offer golden opportunities for an ambitious man, conscious of possessing originality and great abilities. He therefore abandoned pure science, and, after serving with distinction as a consulting surgeon in the Russo-Turkish war of 1877, was appointed Professor of Surgery at Würzburg in 1882. Here he added so greatly to his reputation that, as neither Billroth nor Volkmann would answer to the call, he was recognised as the natural successor to Langenbeck, who resigned his post in 1882.[1] Professor Schleich says that, under his guidance, the surgical clinic at the Charité underwent a thorough reform. "A system of antiseptic drill worked out to the most minute details was set up in opposition to the old beloved habits, with the rigour and pedantry of a military course of instruction."

But it was not long before von Bergmann became convinced that antisepticism was only a transition stage, and that asepticism was the treatment of the future. He did not, as we know, originate the idea; Lister recognised it and approached as nearly as he thought prudent to founding his practice upon it; but such a practice, if carried out in every

[1] Arend Buchholtz, *Ernst von Bergmann*. Leipzig, F. C. W. Vogel, 1911, p. 523; 3te Aufl. 1913, p. 416.

detail, appeared to him to be neither wise nor safe. Von Bergmann, on the other hand, set his intellect to work to make asepticism universally applicable by elaborating and perfecting details, and thus became the great apostle of " aseptic surgery." Much later, in 1892, his methods were formulated and described by his assistant, Dr. Schimmelbusch,[1] and they have been widely adopted throughout the civilized world.

The whole question will be discussed in a later chapter, but it requires a short notice here, because von Bergmann's teaching undoubtedly had much to do with the style and arrangements of the extravagant new hospitals that were built in Germany and elsewhere.

Even at this short distance of time it is not easy to say exactly how the hospital reform of the nineteenth century originated. About 1865 the most celebrated hospitals on the continent, the Allgemeines Krankenhaus at Vienna, the Hôtel Dieu at Paris, the Charité at Berlin, the Julius Hospital at Würzburg and others which have been already mentioned, were hopelessly out of date. The need for rebuilding on a very different scale was urgent, and probably, even if the question of antiseptics had not been in the air, surgeons would have insisted upon buildings with proper ventilation and drainage. No doubt the demand for reform was accentuated by the general acceptance of Lister's teaching, and it may be supposed that the model of construction was suggested by Simpson's propaganda and the new St. Thomas's Hospital. Having adopted the general idea, the Germans improved upon it, or rather they carried it further, and went, as is now allowed, to quite unnecessary lengths by building hospitals which were wasteful of money, space and time. Land was plentiful, funds came in abundance from the state or the municipality, and there was nothing to check experiment or extravagance, for much of which the cunning devices of von Bergmann and his followers are responsible. One of the best known of these vast institutions covers 136 acres, and is like a small town. There are no corridors. Each ward is a separate pavilion, heated by its

[1] *Anleitung zur aseptischen Wundbehandlung*, C. Schimmelbusch. Berlin, A. Hirschwald, 1892.

own hypocaust, as is also the operating block from and to which patients have to be wheeled on trollies in all weathers.

Wonderful accounts came back to England. Whenever a new hospital or a new theatre had to be designed, members of the staff were sent to Germany to see the very latest thing, and, if possible, to devise something better; and one result of all this competition was the magnificent modern operating theatre, without some approximation to which no cottage hospital is now considered complete.

These changes affected the views of the profession about Lister and his doctrine in more ways than one. The mere changes themselves made surgery safer, and the consequent diminution in hospital diseases fortified the belief of his disciples who put it all down to antiseptics, as well as that of his opponents who attributed it all to improvement in hospital hygiene. The gradual introduction of so-called "aseptic surgery," moreover, tended to distract attention from Lister's own teaching, and to a certain extent to discredit it.

The innovations, for which von Bergmann was so largely responsible, were a constant source of sorrow to Lister, but there is no mention of them or their high priest in his correspondence or in the *Collected Papers*.

In von Bergmann's *Life*, on the other hand, there are many references to Lister, in all of which he is spoken of with unstinted praise. The most interesting is one which seems to suggest that von Bergmann was thinking of his own work with regard to wound treatment as compared with Lister's. It was in responding to a toast on his sixtieth birthday: "I have been no heavenstorming pathfinder, my powers of discovery are not limitless (*unerschöpflich*). I have not placed myself in the rank of a Lister and a Billroth. If I have accomplished anything, it has been in the way of critical repetition and improvement, animated by the love of my art, that of a surgeon and doctor."

The only account of the meeting between the two men is in a facetious letter from von Bergmann to his sister describing the Centenary of the Royal College of Surgeons in London

in 1890. He says that at the banquet he sat between Lord Rothschild and Lord Lister, "the latter fortunately speaks German," and concludes: "If you think of the daily invitations to lunch and dine with the surgeons, who all live in worldly superfluity, MacCormac, Lister, Harrison, it is a wonder that I held out so long and embarked at last alive and well at Dover."

In 1874, at von Volkmann's suggestions, Dr. O. Thamayn of Halle translated all Lister's papers into German.[1] In an introduction describing the history and development of the antiseptic treatment he claimed, like a true German, that Kuchenmeister had used carbolic acid in the Fatherland, under the name of spirol, even before it had been employed in France. He declared himself a firm believer in the treatment, though he was impressed by the arguments of Billroth that micro-organisms had not been actually proved to be the cause of suppuration, even allowing that they always accompanied it. He therefore concludes that one may be a thoroughgoing supporter of the treatment but a convinced opponent of the germ theory of decomposition. Lister helped him with the work, but Thamayn's conclusion must have grieved him; for Lister always maintained that

"without this guiding principle, many parts of the treatment would be unmeaning; and the surgeon, even if he should attempt the servile imitation of a practice which he did not understand, would be constantly liable to deviate from the proper course in some apparently trivial but essential detail, and then, ignorant of his own mistake, would attribute the bad result to imperfection of the method."[2]

And again

"With this as your guiding principle, you will find yourselves successful with the antiseptic system of treatment; but without it, whatever theory you adopt, you will ever be walking in the dark, and therefore ever liable to stumble."[3]

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[1] *Der Lister'sche Verband*, Uebertragen von O. Thamayn. Leipzig, Veit & Co. 1785.

[2] *Collected Papers*, vol. ii. p. 158. [3] *Collected Papers*, vol. ii. p. 178.

The allusion to Billroth, who, though a Prussian by birth, was by far the most distinguished Austrian surgeon of that day, reminds us that what has been said of Germany applies in a lesser degrée to Austria. Billroth was a really great man, and an inspiring teacher. He may be said to have founded a school, inasmuch as he trained a number of young surgeons who rose to distinction, such as Czerny, Mikulicz and Wölfler. They carried his influence to Heidelberg, Breslau, Prag and other Universities in Austria, Germany, Belgium and Holland, and with them he maintained an affectionate correspondence and interchange of thought, as may be seen in his published letters.[1]

Amongst his enormous output of original clinical and pathological work, and the claims upon his time as Professor of Clinical Surgery at Vienna, he devoted several years—1868-73—to the study of micro-organisms in connection with suppuration, the results of which he published in a folio volume on what he called Cocco-bacteria septica.[2] He described it as a somewhat strange (*etwas sonderbares*) book, starting with a rather unexplored department of botany often included in zoology, and ending with empirical surgery: the two parts however being, he thought, closely connected. Liebig was his oracle. He did not allow that micro-organisms cause decomposition, and at this time he did not believe that the antiseptic system stood upon a solid foundation, as is shown by the following words: "That which of late years is often lovingly called the antiseptic treatment, is in my opinion only a potential (*potenzirte*) 'Antiphlegmonous,' or as it used commonly to be called 'Antiphlogistic' treatment of wounds," which antiquated term included treatment by bleeding, low diet, purging, and all the thousand and one rational and irrational methods of combating inflammation.

It is said that the last twenty years of Billroth's life (he died in 1894) were not only spoilt by indifferent health but clouded by a melancholy pessimism. This may partly

[1] *Briefe von Theodor Billroth*, 2nd edit. Hannover & Leipzig, Hahnsche Buchhandlung, 1896.

[2] Theodor Billroth, *Untersuchungen über die Vegetationsformen von Coccobacteria septica*. Berlin, Georg Reimer, 1874.

account for the frequent recurrence in his letters of expressions such as these: "If you were not so energetic a supporter of this method I should say the whole thing was a swindle; but still Lister's personality charms me."[1] "I find the failures in Lister's treatment very instructive. I would on no account miss them. Absolute perfection has no interest for me. I am curious what will come after Lister; as a rule such things do not last more than five years."[2] "I share your opinion that Lister's theory still has a hole somewhere, most investigators probably hold this opinion."[3]

But as years went on he became more sympathetic. Thus in 1879 he wrote to Mikulicz:

"Best thanks for your letter from London. I am glad you like British Surgery and British Surgeons. Lister's personality is exceedingly sympathetic. I had already been afraid he was angry with me, because I had not entered immediately and unconditionally upon his ideas and upon his methods; he shows himself a great man also in this, that he is so much master of his creed, that he can afford quietly to wait for the judgment of others. Kindly give him the enclosed letter in which I have thanked him for having received you and Wölfler so kindly."

And finally in a letter to Professor His (August 1879), he said:

"It is nonsense, if I am reported to be an enemy of Listerism (I am in most friendly correspondence with Lister) but I have become more and more an enemy of exaggeration. . . . I do not underrate the enormous practical progress, but when I survey the whole great field of Surgery, its operative part hardly makes up a third, and moreover to a considerable portion of this antiseptics are inapplicable (all operations on the mouth, rectum, bladder, etc.). I therefore can only consider it as terrible onesidedness to identify antiseptics with Surgery."

It is not surprising that Billroth's attitude was misjudged and that he was looked upon as an opponent of antiseptic methods. For this he was found fault with (*verübelt*). But his powerful influence accounts for the slow progress that was made in Vienna, though it did not prevent most

[1] To Volkmann, October 27th, 1875. [2] To Volkmann, October, 1875.
[3] To Neudorfer, an Austrian Army Surgeon who had made himself conspicuous by vehement opposition to Lister, November 1876.

of the surgeons whom he had trained from becoming firm supporters of Lister. None of Billroth's letters to Lister have been preserved.

To deal fully with this part of the subject many more well-known names would have to be mentioned, such as those of Esmarch of Kiel, Tillmans of Leipzig, König of Göttingen, Albert of Vienna and Trendelenburg of Bonn, all of whom adopted and upheld the antiseptic treatment. But lest it should be thought that Germany fills too much of the stage, in this as in other matters, we will now turn our attention to what was taking place elsewhere.

Across the frontier in Russia Carl Reyher was installed in 1872 as Privat Docent in Dorpat, the most German city of the Baltic provinces. In 1874 he spent four weeks in Edinburgh. Whilst the impressions of this visit were fresh, he read a paper at a meeting of the German Surgical Association on Lister's treatment of wounds, short but very much to the point, and including some statistics of three years of Syme's practice, and Lister's three succeeding years in the same wards. These he analysed in a masterly way, showing how misleading even such apparently model statistics must be unless much more detail is given than is usually supplied.[1]

Four years later, in 1878, he gave his experiences as a consulting surgeon to the Russian army of the Caucasus in the Russo-Turkish war. The cases he reported were remarkable, thoroughly treated and far more successful than any others with which I am acquainted. The Russo-Turkish war was not to be compared in size, method, or brutality with the present European conflagration. Reyher could not have foreseen the horrors we hear of daily, but it is interesting to note his conclusion: "Therefore I am of opinion that on the whole (*im Allgemeinen und Ganzen*) the antiseptic treatment of wounds can be carried out in war." [2]

[1] *Die Listersche Wundbehandlung. Vortrag, gehalten in der 3 Sitzung des III. Congresses der Deutschen Gesellschaft für Chirurgie, am 10. April* 1874.

[2] Carl Reyher, *Die antiseptische Wundbehandlung in der Kriegs-chirurgie*, Leipzig, Breitkopf und Härtel, 1878, p. 52.

At a discussion on the application to field service of antiseptic surgery at Woolwich in 1884,[1] Lister told some anecdotes about Reyher: how he classified wounds into "befingerte" and "unbefingerte":[2] how he took out with him to the wars a large spray-producer and a cumbrous instrument for making carbolic acid gauze, and what a high measure of success he obtained; and quoted from a letter of Reyher's "Sind diese nicht herrliche Resultäte?"[3]

Reyher was transferred to St. Petersburg in 1878, and it must be supposed that his firm convictions and successful practice exercised much influence in the Russian capital.

Lister was accustomed to say that Professor Saxtorph of Copenhagen was the first to bring the antiseptic treatment into operation on the continent, but this is doubtful. He was a frequent visitor to Glasgow and to Edinburgh, and may have begun to apply it earlier than the following passages from a letter written to Lister on July 18th, 1870, would suggest:

"It is now nearly a year since I left Glasgow, where I had the opportunity of seeing how the antiseptic treatment of wounds is to be carried out. Every surgeon who has seen the remarkable results of this treatment must feel it his duty to imitate you, and dress the wounds after your principles. I therefore, as soon as I came home, adopted your method, and have used it now continually since that time; and I am happy to say that, although I have not generally succeeded in obtaining complete primary union, except in smaller wounds, still the treatment has proved in other respects extremely satisfactory."[4]

After describing the previous unhealthiness of the Frederik's Hospital, then more than a hundred years old, and the banishment of pyaemia from his wards, he concludes:

"I feel so much indebted to you for what I have learnt in seeing you employing the antiseptic dressing, that I thought it my duty to let you know how things went on in my hospital practice; and I am happy to say that I never tried any innovation which answered so admirably as this treatment of wounds."

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[1] *Lancet*, 1884, vol. i. p. 345.

[2] "Fingered and unfingered."

[3] "Are these not magnificent results?"

[4] *Collected Papers*, vol. ii. p. 156.

Some years later, in 1875, Saxtorph wrote : [1]

" If you ask me what I have observed respecting the effects of antiseptic treatment, I may say that it has not modified, but completely changed my principles of pathology and my surgical practice. . . . The word *hospitalism*, which some years ago found its way from Edinburgh to the Continent, no longer terrifies us; it no longer keeps us from performing operations in the infirmary, and you seldom meet with a case that could be called a case of hospital disease."

Before closing this sketch of the progress of events in those continental countries most exposed to German influence, the name of Lister's old friend Tilanus of Amsterdam, who died in 1914, must be mentioned, to remind the reader that Holland was not far behind in the race; and that of Kocher, who still adorns the Chair of Clinical Surgery at Berne, to prove the same with regard to Switzerland. When Kocher was called to Berne in 1872, he wrote to Lister asking for full instructions, and promising to give the method a fair trial. For long he has enjoyed the reputation of being perhaps the most thoughtful and suggestive surgeon of his day. His influence has thus been very great. It has been exerted in favour of aseptic methods which, after the ' fair trial,' he adopted in preference to rigid antisepticism according to Lister.

It might have been expected that France, prepared as it was by the successful investigations of French chemists into the subject of fermentation, would have welcomed Lister's discovery with acclaim. Far from doing this, however, in the words of a German commentator,

" France, the land of fashions was occupied with the discussion of so many other methods which their inventors advocated in preference to this new doctrine from abroad, that it advanced with but tardy steps. One particular method, the ' pansement ouaté of Alphonse Guérin,' was set up in opposition to Lister's treatment and held its own until 1880. It was because in France the mere method of dressing was looked upon as the hinge upon which antisepsis turned, that the essence of Lister's teaching was long in obtaining a secure foothold." [2]

[1] *Collected Papers*, vol. ii. p. 247.

[2] Vilmos Manninger (Budapesth), *Der Entwicklungsgang der Antiseptik und Aseptik*, Breslau, J. U. Kerns Verlag (Max Müller), 1904, p. 100.

This is a fair comment, and yet there were four Parisian surgeons, all of whom passed away during the year 1914, Terrier, Perier, Berger, and Championnière, who never ceased to struggle for the reform of surgery and the success of antiseptics. Of the last and most active of this group special mention must be made.

To Dr. Just Lucas-Championnière belongs the credit of having produced the first complete account of antiseptic surgery. It took the form of a small book of 150 pages, published in 1876;[1] a larger edition appeared in 1880, which was followed in 1909 by a stout octavo volume of lectures on the same subject.[2]

But this was not his earliest effort to convert his fellow-countrymen. In the introduction to the first edition he says:

"I had the good fortune to learn to appreciate antiseptic surgery almost from the very start, on the occasion of a visit I made to Glasgow in 1868, when as yet the method was unknown in France. I had the honour of seeing and hearing Professor Lister. The principles of the method had been laid down, but their application was far from being as perfect as it is to-day. Still I was so struck with what I saw that I made up my mind to do my best to make it known, and my first article on the subject appeared in the Jan. number of the *Journal de Médecine et de Chirurgie pratiques*, 1869."

Further on he says:

"In the early part of August, 1875, I went to Edinburgh to study it.

During the meeting of the British Medical Association, to which I had the honour of being invited, and then after this Congress, I was present at all Professor Lister's demonstrations and attended his hospital practice. The great kindness of the Master and the perfect courtesy of his House Surgeon Mr. Rice gave me the opportunity of very complete study. I even had the chance of seeing the treatment carried out by other surgeons.

On my return to France I published a series of communications on the subject (*Journal de Médecine et de Chirurgie pratiques*, Oct. 1875, Feby. 1876). I also spoke at the Société de Chirurgie. But,

[1] *Chirurgie Antiseptique*, par le Dr Just Lucas-Championnière. Paris, J. B. Ballière et Fils, 1876; 2me édit. complétement refondue, 1880.

[2] *Pratique de la Chirurgie Antiseptique*, Paris, Steinheil, 1909.

more important than all, I had a pretty long experience of it during my period of office at the Hôpital Temporaire, where for six months I performed a good number of operations and carried out many dressings."

At first few listened to him, and the hospital authorities made it almost impossible to obtain Lister's dressings. But, by dint of untiring perseverance, this difficulty was overcome, and, one by one, his colleagues sought his help and advice. Some of them even professed a rather tepid faith. But, in spite of all, very little antiseptic work was being done in Paris in 1875.

In the introduction to the 1880 edition of Championnière's book we are left in some doubt about the practice of his colleagues. Speaking of his own he says: "In a word, in Paris hospitals, even the worst, we are in a position to do the most formidable operations, and that with the same security as if we were in the country where the air is purest. We thus have all the external advantages of the country and all the resources that hospital accommodation affords."

But he speaks of the 'most incredulous,' as if they still abounded, borrowing one or another of Lister's ideas: "Everything is put under contribution, and to-day you may see in many services in Paris, hands, instruments and patients washed in carbolic acid lotion, a thing which formerly was quite unknown."

He also refers to the rival systems almost in the same words as the German critic. "The cause of these disputes no doubt consists in this, that Surgery persists in looking upon Lister's system simply as a kind of dressing, and not as a method of treatment. Nobody who has carefully studied the matter or tried it for himself can possibly fall into such an error."

In all this there is rather a note of anticipation than of hope fulfilled. It sounds in his concluding words: "A few years ago Paris hospitals were reckoned amongst the very worst, even by some of their own surgeons. Now surgery may be as well carried out in them as anywhere else. You may even see a patient recover after Caesarean section."

In 1909 he told his class of past difficulties and obstructions; for example, how in the war of 1870 his chief prevented him

from bringing carbolic acid to his field hospital where patients were dying of septic disease, and it was taken back unopened to Paris.

"I only remind you," he says further on, "as a matter of history, that for many years I was the subject of a sort of persecution on the part of those whose scientific repose I was violently upsetting, a persecution which only our contemporaries can now remember.

"Since this time, however, all has changed; those who were most opposed have been forced to surrender. It has been found impossible to refuse to accept some portions of the advance, and a whole crowd of innovations had to be adopted which have revolutionized surgery for all the world."

But, alas, by this time the short Parisian day of pure Listerian antiseptics had already come and gone, and Championnière saw with much regret, and yet not without hope, those whom he had convinced with so much difficulty already coquetting with what he regarded as the aseptic heresy.

"But have those who have succeeded him [Lister] during the last forty years," he asks, "changed any fundamental fact in his theory or in his method? Certainly not! If progress has been made during these forty years it has only been progress in details.

The *theory* of the healing of wounds according to Lister remains intact; and the *practice* which is thought to be so extraordinarily different will certainly return to the judicious use of antiseptics which many surgeons, 'antiseptiques honteux,' who call themselves aseptic, are even now employing more or less regularly and would employ still more if only they knew more about them."

Lucas-Championnière, who was a particularly attractive man, became one of the foremost of Parisian surgeons. He was a frequent visitor in London and kept up an occasional friendly correspondence with Lister, of which the following letter written from St. Jean de Luz in 1907 may be given as an example:

"MON CHER MAITRE,

J'ai reçu et relu la petite brochure quê vous avez eu la bonté de me faire envoyer et je voulais vous en remercier lorsque je suis parti en voyage pour le midi. J'étais assez fatigué ayant depuis quelque temps mené une existence assez active à Paris pour la fondation d'une œuvre d'enseignement libre des hôpitaux de Paris dont je

suis le Président et où, comme vous le pensez bien, on parlera souvent de vous.

J'ai appris ici que le 6 avril est la date de votre naissance et je veux vous envoyer à cette date mes bons souvenirs de disciple qui se joindront à toutes les voix qui vous porteront la reconnaissance de la chirurgie et de l'humanité.

Je suis bien au regret que l'état de ma santé ne me permette pas d'aller à cette époque en Angleterre me joindre à vos élèves et vos amis.

Mais j'espère bien qu'au cours de cet été la bonne saison me permettra de le faire.

En attendant je travaillerai à l'histoire de votre œuvre et j'espère vivre assez pour qu'une publication Française vous rendra la justice que l'humanité vous doit.

Agréez le respectueux souvenir de votre dévoué

J. LUCAS-CHAMPIONNIÈRE."

It is said that Paris is France, and for our present purpose the saying is sufficiently accurate. Lister had, it is true, a certain number of friends and supporters in the provinces, but their writings and doings are not of sufficient importance to detain us further.

In Italy all surgical reform was slow, and the adoption of antiseptics was belated. Writing in 1878, Dr. Giuseppi Ruggi of Bologna said: "Italy is the most indifferent of all nations and seems as if she neither interested herself nor wished to interest herself in this method of treatment which has been estimated so highly by the great surgical leaders of Germany."[1] He mentions seven Italian surgeons as the only rare exceptions who had at least given it a trial. One of these, Bottini of Pavia, who was highly successful amidst disgustingly insanitary surroundings, speaks in 1878 of the general acceptance in other countries after some systematic opposition, whilst in Italy, he adds, the doctrine "has been suffocated, up to that time, by the terrible and insidious weapon, apathy."[2]

[1] "Di tutti le nazioni l'italiana è la più indifferente, e pare che neppure s'interessi nè si voglia interessare di mettere ad esperimento questo metodo *guidicato tanto benignamente* dalle più grandi notabilità chirurgiche della *Germania.*" *Alcuni esperimenti sulla medicatura alla Lister—Commentario Clinico di Pisa, 1878,* Anno ii. nn. 1, 2.

[2] E. Bottini, *La Medicazione Antisettica.* Torino, Vercellino e Comp. 1878.

Another Italian surgeon, Devecchi of Turin, in the same year, urges his compatriots, if not to adopt, at least to experiment with a method now pronounced to be good by the mature experience of other countries.[1]

Far away in the South, Albanese of Palermo met with some success in his wild practice, which, owing to the prevalence of brigandage and the thirst for vendetta, was like military surgery on a small scale. But no Italian surgeons, as far as is known, entered in the same way into Lister's life, either by personal intercourse or by correspondence, as those in other countries which have been mentioned. Italy therefore needs no further mention, and the same may be said of the Iberian peninsula.

There remains, therefore, only Belgium which, placed, as it were, between the upper and the nether millstones, came to some extent under the influence of both France and Germany, but produced no prominent advocate or opponent of antiseptic surgery.

Finally, with regard to America, where, in spite of the frequent visits of its surgeons to the Continent of Europe and their admiration of German methods, progress was even more slow than in Europe. Dr. Robert F. Weir, Surgeon to the New York and Roosevelt Hospitals, may be called as a witness. Writing in November 1877, he says :

" It is only lately that, in America, attention has been given practically to the teachings of Lister in respect to the treatment of wounds. In fact, aside from an article by Schuppert in the *New Orleans Medical and Surgical Journal*, little or nothing has appeared in our medical journals relative to the results of the so-called antiseptic method. Within the past year, however, a change has occurred, due probably both to the interest excited by the personal expositions of Lister at our late Medical Congress at Philadelphia, and also to the satisfactory results that have ensued from this treatment in the practice of many German surgeons with large hospital experience. The reason why American surgeons—who justly have the reputation of being eager to seize upon any improvement in their art—have been

[1] P. Devecchi, *Contribuzione allo studio della Medicazione Antisettica del Lister*. Torino, Roux e Favale, 1878.

tardy in testing the success of this mode of treatment, may, perhaps, be stated as follows: 1. That the treatment, as enunciated by Mr. Lister, has been repeatedly changed in its details; 2. That it was too complicated, and demanded the supervision of the surgeon himself, or, in a hospital, of a carefully-trained staff of assistants; 3. That many who had tried it had been unsuccessful in the cases where the essay had been made. But the most weighty objection which was asserted or entertained, was the positiveness of the enunciation of the germ-theory in explanation of the process of decomposition in the secretions of a wound." [1]

It is not difficult to appreciate the American point of view. Surgeons were educated on the same lines as British surgeons; but the training was shorter and sadly deficient. Those who aimed at the higher positions were obliged to resort to post-graduate study, mostly in Europe, and gained their clinical experience on their return. Then began the high-pressure existence of that "New Country," and they became essentially practical surgeons,—craftsmen in the best sense of the word, devisers of new operations, improvers of surgical technique, and naturally indisposed to trouble very much about abstruse scientific problems. But when it had been proved elsewhere that the new method had great practical value, it was quickly taken up and successfully applied.

It is generally said that Lister's teaching was more readily accepted abroad than in his own country. A wide survey, such as we have taken, shows that this is only to a limited extent true. German, Swiss and Scandinavian surgeons were the exceptions. The German surgeons were numerous, energetic, and very prolific and persuasive writers; their influence upon the rest of the world was undoubtedly great, and, to some extent, the rest of the world waited to hear what their verdict would be.

[1] Robert F. Weir, *On the Antiseptic Treatment of Wounds, etc.* (reprinted from *New York Med. Jour.* Dec. 1877, Jan. 1878). New York, D. Appleton & Co. 1878.

CHAPTER XXII

CHRONOLOGICAL. LYME REGIS. VISIT TO CONTINENTAL HOSPITALS (1870-1876)

In the two foregoing chapters it was necessary at times to travel far away from that period of Lister's life which prompted the digression. A more orderly account of events during his Edinburgh Professorship must now be given.

During these few years his literary output was large; no less than ten publications on matters connected with antiseptics and two on fermentation having appeared between 1870 and 1876. Almost all of these have been already referred to. They occupy more than 200 pages of the *Collected Papers*, and for the most part are connected with modifications of the method of treatment, though including many new and important clinical and pathological observations.

One only requires further mention. On the outbreak of the Franco-German war, in August 1870, high hopes were entertained in some quarters that military surgery might share the benefits that had been conferred on civil practice. The Germans did their best, the French very little. The sound of battle caused the usual rush of British and American volunteers, who were welcomed by both sides in those days of comparatively ill-developed army medical services.

Lister's advice was sought, and he wrote a short article entitled " A method of antiseptic treatment applicable to wounded soldiers in the present war."[1] It described the simplest method he could devise for using carbolic acid under the circumstances, and emphasized the importance of applying

[1] *Brit. Med. Journ.* 1870, vol. ii. p. 243 ; *Collected Papers*, vol. ii. p. 161.

it both to septic and aseptic cases in order to maintain the highest state of hospital salubrity. He alluded to the existence of other antiseptics, but made no attempt to indicate how they should be employed.

Notwithstanding valiant efforts to follow these instructions, there is no doubt that the hopes of both British and German surgeons were disappointed. It was found to be impracticable to accomplish the preliminary purification of more than a small proportion of wounds on the battlefield, as unfortunately is still the case, in spite of modern discoveries such as the differentiation of micro-organisms and sero-therapy, and notwithstanding the high state of development of many army medical services.

Later experience has shown that the limitations of antiseptics in war depend on many things: the climate, the soil, the nature of the projectiles, the habits of the belligerents and the idiosyncrasies of the medical officers. Surgeons of firm convictions and great determination, under favourable circumstances and in campaigns of moderate dimensions, have accomplished marvels. But they are the exceptions. Moreover, the malign influence of those scientific men whose genius is devoted to devising engines of death has, so far, more than counterbalanced that of their colleagues whose efforts are directed towards the saving of life. The problem has therefore become more difficult and still awaits solution. Will it be solved by means of some new and undreamt of discovery? Or will increasing horrors lead to the abolition of war and make the solution unnecessary?

Lister's influence on military surgery has nevertheless been great, although it has failed to accomplish all that was hoped. The mortality after amputation has diminished enormously, and secondary operations such as trephinings, abdominal sections, the extraction of bullets and fragments of shells, can often be carried out with that complete safety which the adoption of the strictest antiseptic precautions secures. Moreover, a certain number of wounds are treated successfully from the first. And another most important change that has come over military surgery in consequence of his teaching, helped on as it has been by the discoveries of bacteriologists,

is the more intelligent treatment of infected wounds. The result in the present war is that, although the vast majority of the wounds become septic before they come under treatment at collecting stations or field-hospitals, the proportion of recoveries is very much greater than it used formerly to be.

There is a short reference to these matters in one of Lister's letters to his brother written from Penmaenmawr, September 1st, 1870.

"I am much obliged to thee for looking after the proof of my article, and glad that it will appear next Saturday. I had noticed the account of the treatment with Carbolic Acid and oil in the *Times*. I also saw in one of the papers yesterday a description of the starting from Paris of the ambulance of the Anglo-American Society with Dr. Sims [Marion Sims] as head surgeon of the American division of it and Dr. McCormack[1] [*sic*] of Belfast, head of the English division. Dr. McCormack has been getting capital results from antiseptic treatment for some time past, and he visited Edinburgh last winter and saw my practice there. It is very satisfactory for both the chiefs of this ambulance to be well disposed towards antiseptic treatment. [Marion Sims alas! had to own that their ambulance at Sedan became completely septicized.[2]] From to-day's paper as well as one of the leaders in the *Times* of yesterday I infer that MacMahon's attempt to relieve Bazaine has already failed! How sad are the accounts from Strassburg!"

This and another letter, dated November 21st, 1870, show something of the keen interest he took in the war and the direction of his sympathies.[3] The second takes us back into the Edinburgh atmosphere.

[1] Afterwards Sir William MacCormac, Surgeon to St. Thomas's Hospital.

[2] *Trans. Internat. Med. Congress*, London, 1881, Section "Surgery," p. 36.

[3] At the present moment and in this connection it is interesting to read these words from an earlier letter to his father dated June 24th, 1866:

"How dreadful the state of things on the continent is. To-day's news, of the defeat of one of the main divisions of the poor Italian army, is very distressing, though too much in accordance with what was to be expected. As to the miserable minor German states, I confess it does not grieve me greatly to see them swallowed up by Prussia, as I dare say the inhabitants may in the end be better off under a single strong Government. But to what extent Prussia may be compelled to disgorge her unlawful plunder before the war is over, or what other calamities may happen who can predict?"

" Dreadful indeed is the bare idea of the possibility of our going to war with Russia again. We can only hope it may be averted. But I can't help fearing Bismarck will dally with us till he has made an end of France and then dictate his own terms to us.

We have got a splendid number of students, 183 first year's medicals! And I have a grand class: so different from last year's in their behaviour. Every time I have entered the theatre to lecture, (and to-day has been the 5th) they have greeted me with a warm cheer."

In the same letter there is a reference to the purchase of a house at Lyme Regis in Dorsetshire, which the two brothers and a brother-in-law acquired at this time, and for some years held in common, though it afterwards became Arthur Lister's property only. Many short vacations were spent together in that delightfully primitive and then remote little town, for the nearest station, at Axminster, was seven miles away. The house " High Cliff " stands, as its name suggests, high above the shore looking over a wide expanse of sea and in full view of the long line of flat-topped orange and purple headlands which leads on to Portland Bill, 25 miles away to the southeast. It is a luxuriant country, rich in meadows, woods and moorlands, on the very edge of Devonshire, which it much resembles; intersected with countless valleys along which many a stream makes its way into the sea or the river Axe.

A special feature is the undercliff or landslip which stretches westward to the mouth of the Axe and the village of Beer, nestling under a chalk cliff which looks strangely out of place amongst the older formations.

Thus Lyme affords an endless variety of walks and peculiar charms for the naturalist. Here Lister greatly increased his knowledge of field ornithology and shared in many of his brother's mycological investigations.

1871 was the year of his Plymouth address, about which he wrote to his brother, on August 27th, from Ambleside.

" I am much disappointed to find my address published in yesterday's number without a proof having been sent to me. Not only

am I prevented from introducing various important details, but the publication in the *Lancet* is prevented.

However these two things together make me the more resolved to send a copy to almost every medical man in the country. . . . My visit to Manchester proved quite a success. Lund had some capital cases of compound fracture to show me, doing excellently under antiseptics, and he was able to get some hints from me that I hope will prove useful to him. Also Mr. Cooper Forster, a surgeon of Guy's, happened to be there visiting Lund and he was much pleased and said he should tell everyone he saw in London that they must *see* the thing to understand it."

The years 1873 and 1874 were busily occupied with the bacteriological work and clinical improvements described in previous chapters, to which less and less time could be allotted as University duties and private practice increased.

One or two letters to his brother will show how the time was passing.

"MRS. HAMILTON'S,
OLD WELL ROAD,
MOFFAT. 10 Sep. 1873.

MY DEAR ARTHUR,

Thee will be surprised to see the above address. We came here yesterday, that I may write a paper which I have promised to the Editor of the *Microscopical Journal*, to give an account of some observations I have made of late on Bacteria &c., of which I hope I may soon have an opportunity of telling thee in person, as we should like to peep in upon you on our way from this place to Cornwall where I hope to write, in some secluded spot, the *opus majus* of the paper for the *Transactions of the Royal Society of Edin.*[1] It was plainly out of the question to try to get my first paper (for the *Microscopical Journal*) done in time for the next number, if we went at once to Cornwall. So we decided to come here in the first instance, as soon as I should have put the plates (three in number) into the lithographer's hands, and this was done yesterday morning.

And most charming this place now is, so different from its appearance as *we* knew it [referring to visits paid to Moffat with their father]. Now the little gardens are full of bright flowers, the trees in full unimpaired summer foliage, the corn fields golden with the late harvest, the lower hills emerald green, and the higher ones purple with heather-blossom. I have to-day been (with Aggie) meditating on the Gallows' Hill, where *fungi* are evidently in profusion. It

[1] The address was given viva voce, and not printed till 1875.

seems but yesterday that thee and I were there together: and Agnes pointed out to me the scattered scales of a fir cone, no doubt the work of one of thy beloved crossbills.

Now having had lunch and a little quietness after it, we propose to stroll out again and (I daresay by the banks of the Moffat) combine work at my paper with the enjoyment of this charming scenery. Our cottage is very near Hartfell House which is full."

The following is dated Edinburgh, November 19th, 1873.

"Of course my engagements, like thine, prevent much work at fungi. Still I have been doing something with the microscopic fermentaters. I thought I would look at the Pasteur's solution in a test-tube we charged from one of the glasses in thy room the night I left for Edin., now nearly two years ago: viz. the one containing the oval torula, originally derived from a rain-drop.[1] Eight months after that Christmas time I found in the test tube a delicate filamentous fungus bearing the oval torula as its conidia. But these conidia were not exactly like the original torula. Well I have found now that there is still the plant alive in the test-tube: evaporation having been only extremely slow in consequence of the cotton wool packing. And now, on inoculating a fresh glass of urine with this two years old specimen, I get back in all its original beauty my old oval torula, perfectly unmixed with filaments, as pure a torula as can be conceived. And it grows equally pure in Pasteur's solution.

This result pleases me very much. Without our method of keeping an organism unmixed, we could not possibly have thus demonstrated the origin of this torula from a filamentous fungus. Then again the distinction between this torula and the yeast plant is very strikingly shown by the fact that the 2 years old Pasteur's solution in the test tube is still distinctly *sweet*, whereas the yeast plant would have worked off all the sugar in a very short time.

But meanwhile this sort of thing absolutely stops the progress of my *manuscript* which remains exactly *as I left it at Lyme ! ! !*

My class promises to be the largest I ever taught, and their attention and order and earnestness were never surpassed. So I am encouraged to take some pains in preparing my lectures for them.

The spray producer I am sorry to say is not yet right.

As to the machine for the gauze, it has not yet arrived, and I have not yet gone to stir up the manufacturer."

The reader will remember that at this time Lister held the view that both torulae and bacteria were developed from filamentous fungi.

[1] See page 270.

It was in the early part of 1875 that the long article on "Recent improvements in the details of antiseptic surgery," appeared in the *Lancet*, extending over no less than seven numbers.[1]

The most important events of the years 1875-6 were a continental journey and his appointment to the General Medical Council. The former brought him into personal contact with the chief German surgeons of the day, the latter made him intimately acquainted with many leaders of the medical profession in London.

On the continental tour the party consisted of Lister and his wife, his brother and sister-in-law and two nieces. The first part was devoted solely to recreation, the second to a progress through various German cities to see what manner of fruit his doctrine was bringing forth. After the usual difficulty in tearing himself away from his work, the Edinburgh contingent joined the others who had been kept waiting for them at Cannes. There was a boating expedition to St. Honoré and Ste. Marguerite, then interesting because of the recent escape of Marshal Bazaine who had been imprisoned there in 1873, after his condemnation for treachery in giving up Metz. They drove along the Cornice Road through Genoa to Spezzia, the two brothers minutely interested in such common objects of the country as the mechanism of an oil press, to the despair of the courier to whom time was important and these details quite insignificant. From Pisa they came to Naples, where Lister, full of his classical memories, made the orthodox undignified entry into the Sibyl's Cave and missed nothing which, like the Grotta di Cane, or the lake of Avernus, had a Virgilian or Horatian flavour. From Sorrento the brothers broke away from their party to see the Blue Grotto at Capri, and themselves almost reached the Stygian shore; for on the way back a sudden storm made the return to Sorrento impossible, which so alarmed the Italian sailors that they fell to praying on their knees; and it was with great difficulty that

[1] See page 315.

the steersman was forced to stick to the helm as they drove before the wind the eighteen miles to Naples in constant danger of being capsized. Next day they telegraphed to their ladies, who had fortunately been assured that the boatmen would never have left Capri in such a storm, and were therefore in blissful ignorance of the peril to which the travellers had been exposed.

Ten busy days were spent at Rome, where they stopped at the old "Roma" hotel in the Corso, and from a strange old suite of rooms with cushioned window-ledges looked down upon the narrow swarming street. Letters home tell of the fascination of ancient and mediaeval Rome, of the charm of Hadrian's Villa, and of the sunset view from the Villa d'Este, and how on the drive back across the Campagna Lister had a chill followed by a rheumatic shoulder which troubled him till, as he was firmly convinced, it was suddenly and permanently cured by the cold air in the Adelsberg caves some weeks later.

After Rome came Florence and Milan, reviving memories of the wedding tour nineteen years before and successful struggles with the Italian language. Whit-Monday was spent at Bellagio, with green figs on a stick for lunch, and fireflies in the hedges after dark. Four days was a short time in which to "do Venice very thoroughly," especially with a rheumatic shoulder, but it was accomplished. A night voyage took them to Trieste, soon followed by the Adelsberg caves with their strange stalagmites and the eyeless proteus and the miraculous cure of the shoulder. And so they came to Vienna, to which three days were devoted before they passed on to Munich, where what may be called the professional part of the journey began. Up to this point Lister seems to have thrown off his surgical cares and devoted himself to the pleasures of travel. Probably, in his then frame of mind, there was not much of medical interest to attract him in Italy; but it is surprising that we have no record or diary of those few days in Vienna, and do not know whether he saw Billroth on this occasion. There is no mention of such a meeting in Billroth's published letters.

The serious aspect of the visit to the German University

towns is set out at considerable length in the opening address to the surgical section of the British Medical Association at Edinburgh,[1] in August 1875 of the same year.

For a description of a part of the lighter side we are indebted to a paragraph in the *Lancet* of June 19th.

"The progress of Professor Lister through the university towns of Germany, which he is visiting chiefly, we believe, with a view to inquire into the mode in which the antiseptic treatment is carried out on the Continent, has assumed the character of a triumphal march. On his recent visit to Munich he met with a most enthusiastic reception. [Professor von Nussbaum was at the station on the morning of their arrival, in evening dress, with a large bouquet for Mrs. Lister.] At a banquet given to him nearly all the Professors of the Medical Faculty of the University, and many members of the Government, Town Council, and Medical Society of Munich took part. The guest was welcomed by Professor Nussbaum in the name of the Minister, von Pfeuffer, and Professors Ziemssen, Seitz, and others were amongst the speakers. The students of the University also sent a deputation to Professor Lister, to express the esteem and high appreciation they had for the originator of the antiseptic treatment, which is carried out with excellent results at the different hospitals in Munich. From Munich he went to Leipzig, where, as is well known, the principles of antiseptic surgery have been faithfully adopted by Professor Thiersch, who, however, maintains the superiority of salicylic acid over carbolic acid. On the 8th inst. there was a 'Lister-Banket' in the Schützenhaus, at which some three or four hundred persons were present, including nearly all the professors, many of the medical practitioners of the town and a large number of medical students. Thiersch proposed Prof. Lister's health in a drily humorous speech, which was couched in most complimentary terms and was loudly applauded. [Lister's discovery, he said, like other great discoveries, has had to pass through the usual three stages: the first when the world smiles and shakes its head and says 'It's all nonsense'; the second with a shrug of the shoulders and a look of contempt 'It's the merest humbug'; and finally 'Oh that's an old story; we knew that long ago.'] Professor Lister, in his reply (which was in German), took occasion to tell the Leipzigers that he had tried salicylic acid and found it inferior to carbolic acid; although he would willingly have adopted it had it been better, for it was the *principle* of antiseptic surgery, and not this or that acid, that he contended for. Professor Volkmann, who had come from Halle with many of his colleagues and students, then proposed the health

[1] *Brit. Med. Journ.* 1875, vol. ii. p. 769; *Collected Papers*, vol. ii. p. 247.

of Mrs. Lister [and the other ladies] who were present in the gallery; Professor Carus gave the 'University of Edinburgh'; and toast after toast followed, the proceedings lasting beyond midnight. One very novel feature was the introduction of two songs written in honour of the guest of the evening, and set to well-known students' melodies. They were sung by the whole company, and they abound in words of welcome to Professor Lister and praise of antiseptic surgery. One of them, entitled 'Carbolsaüre Tingel-Tangel,' is full of witty allusions to the germ theory, bacteria, and antiseptics, the special virtues of salicylic acid not being forgotten. We believe Professor Lister intends visiting Halle and Berlin where doubtless he will be cordially received." [1]

Mrs. Lister describes her husband's visit to Thiersch's clinique in the morning of this day, and an early dinner at Thiersch's house, with amusing allusions to the many mementoes of the great Baron Liebig—Mrs. Thiersch's father—and how the hostess herself added a dash of Liebig's Extract to the soup after they had taken their places at table. "Very interesting it was to see such a nice specimen of German family life. Nice people, very. He, a rather grave looking man, with much tenderness in him. She, perfectly unaffected, self-possessed, bright and competent, in a quiet way directing almost every movement of the handmaiden who was aided in waiting by the little girls—a very nice person."

In another letter she gives her own account of the banquet.

"With Mrs. Carus and her two daughters I had tea, and then we four went in a cab to the Schützenhaus, a large building in which concerts, etc., take place. We went upstairs to the gallery above one end of the room, and I heard Joseph's voice, and was sorry to find that he was just finishing his speech in reply to the toast of his health, which had been proposed by Professor Thiersch. Joseph's speech was very warmly received, and he heard afterwards that the students were very much pleased by his speaking in German. About 250 people were present, about 100 Leipzig students, and about 50 from Halle. Some Professors from Halle also came, among them two Professors Volkmann, father and son, the former Professor of Anatomy, 78 years of age! the latter, Arthur and John know well by name. It is a very handsome room, and the effect looking down from where we were on the great number of people, and the thought of the object of it all—well it was a great thing to see, as it still is and always will be to think of. Joseph sat between Professor

[1] *Lancet*, 1875, vol. i. p. 868.

Thiersch and Professor Volkmann junior. Soon after Joseph had spoken, four students left their supper places and sang, in parts, a German song, and then the band, in the gallery opposite to that in which we ladies were, played, while the beautiful supper proceeded a little further. There were many speeches (I wish I had understood them). Toasts were proposed and warmly responded to, but no ' speeches in reply ' were made except Joseph's. Professor Carus . . . proposed the University of Edinburgh and spoke most handsomely of Joseph—calling him ' facile princeps ' there. A medical man from Dresden spoke, and one from Magdeburg, the hospital of which was the most unhealthy in Germany, and now, through antiseptic treatment, it is healthy. Everybody was most cordial, and Joseph was in many toasts, either by himself or in connection with antiseptic principles, or united with Profs. Thiersch and Volkmann, and how the glasses clinked—and how the ' Hochs ' (' Er lebe hoch ' or ' Sie leben hoch ') resounded—strengthened by the roll of a drum and the blowing of several trumpets ! The students sang, very nicely, ' John Anderson my Jo,' in German ; and two songs written by students for the occasion. . . . The ladies were not forgotten—but they tried to get quite out of sight when their health was proposed under the title of ' strangers in the gallery ' . . . Next morning (Wednesday), Joseph and the King of Saxony attended Prof. Thiersch's clinical lecture ! It seems that the late King was very fond of science—and he used to go every year to Leipzig, and attended the lectures by various Professors—and, as Prof. T. told us, when he had listened to all kinds of *ologies* till he became quite *dull* ! he went to the hospital cliniques to be refreshed. This is the first time the present King has visited Leipzig, and people seemed inclined to think that his going to the University etc., was merely with a view to his own popularity. However, he appears to be a very superior man, and very well educated, as his father endeavoured that all his children should be, and he seemed to take a great interest in all that he saw. Joseph was to be at the hospital before 8.30 a.m., the hour at which the lecture begins, and at which the King was to arrive. Prof. T. was quietly making concluding arrangements—placing chairs for the King etc. When his Majesty arrived he was first conducted by Prof. T. to one of the wards, decorated in his honour, and then brought to the operating theatre. There Prof. T. presented Joseph to him, mentioning his having introduced antiseptic treatment—the King shook hands with him, and they sat down near each other. An operation was performed for the King's instruction, the removal of very large growths, called loose cartilages, from the interior of a knee joint. Prof. T. explained that without antiseptic means the operation could not have been undertaken. The operation was to be a bloodless one—and a new india rubber band had been provided.

In being put on, the band broke—rather a trying thing under the circumstances—but Prof. T. showed no discomposure, and remarked that for a ' Feiertag ' everything must be new, but that the material was not good. The King enquired of Joseph the nature of the loose cartilage, and in order to reply Joseph moved to a chair next but one to the King—a minister being between them. The King bore the operation quite well—it was thought that some of his attendants did not like it much. Afterwards, when he had left, and the students were for the most part gone, Prof. T. was going to perform another operation, upon a face. Joseph made a suggestion regarding it, and Prof. T. asked him to do the operation, which he did—assisted, with great willingness, by Prof. T.'s assistants."

The visit to Halle was at least equally gratifying though there was no public welcome. Volkmann took Lister to the hospital, and in the crowded theatre " proceeded to show a great many excellent cases in which splendid results of antiseptic treatment had been obtained. It did Joseph's heart good to see them, and altogether his visit to Prof. V. was a great interest and pleasure to him, while Prof. V. was much delighted to see him."

Mrs. Lister also describes the attentions they received from Bardeleben in Berlin, and how he showed Lister his results in the Charité Hospital, and took him to Langenbeck's hospital. " His visit there was very interesting, as he found Langenbeck just about to perform his first antiseptic operation ! The case was one in which the knee joint might have to be opened into, and he showed his belief in the antiseptic principle by availing himself of the protection of the treatment."

After leaving Berlin they went to Magdeburg, where Lister missed seeing Hagedorn, the principal surgeon there at the time. He was very warmly received at Bonn by Professor Busch and his assistant Madelung, who had visited Edinburgh the year before.

The last important surgical centre visited was Heidelberg, but there is no record of what he saw of the clinics of Simon and Czerny.

They reached Edinburgh towards the end of June, the journey being beguiled by reading Tennyson's *Queen Mary*, which occupied him all the way from London to Edinburgh.

" The mere fact that it was so engrossing is a proof to me that it is no common dramatical production.

It certainly comes nearest to Shakespeare of any English play other than S's that I have read, as regards the naturalness of the characters and the manner in which the parts are sustained.

But it is not Shakespeare by a long long way. Shakespeare, dealing with such a subject, would have given us expressions of human passion and emotion that would have lived in our memories as no passages in this play will. And how poorly the patois of the old woman takes the place of comical bits which W.S. inserted to enliven his tragedies.

Yet the play is much better than I expected and I hope to read it over again carefully." [1]

His return was welcomed almost like that of the prodigal son. Mrs. Lister wrote on June 23rd, 1875:

"Joseph has been most warmly received by the students. Yesterday he attended an operation by Mr. Annandale at the Infirmary at which a very large number of students were present. When Joseph went into the theatre they gave him a great and long-continued round of cheering. And to-day, at his lecture, he had a very large attendance and was received with great cheering. At a meeting of some of his colleagues yesterday he had also a very warm welcome."

In August came the British Medical Association meeting in Edinburgh, with its two demonstrations. One of these, dealing with fermentation, according to the account of it in the *Courant* of August 7th, took place

"in the Physiology class room under the presidency of Professor Burdon Sanderson.[2] There was a crowded attendance, and the whole of the time—two hours—over which the sitting extended was taken up by Professor Lister with a demonstration of his method of investigation into the nature of putrefaction and other fermentative changes. At the close of the demonstration, the chairman, in moving a vote of thanks to the Professor, said there could be no greater pleasure afforded to them than that of being allowed to look into the mind of an investigator so pre-eminently successful and resultful as Professor Lister, and he was sure all those present must have perfectly understood the extreme importance of the results at which he had arrived. They had been listening to the development of a most important biological discovery—a discovery which had a very practical bearing upon the pathological questions with which the discussion of the germ theory was closely related."

[1] Letter to Arthur Lister, June 23rd, 1875.

[2] Afterwards Sir John Burdon Sanderson.

It is possible that the writers of the six papers which were "held as read" became impatient. Not so, however, were the rest of the audience, according to Mrs. Lister's account of the meeting.

"8. August 1875.

I must send a few lines to tell you that Joseph's physiological demonstration on Friday was exceedingly successful. A large audience listened with great interest for two hours. Two hours was all the time at the disposal of the physiological section, and three quarters of an hour, at the commencement, had been allotted to Joseph by Dr. Burdon Sanderson as President. But additional time was again and again accorded to him by acclamation, and he continued till just about the conclusion of the two hours, when the President said if there were a few minutes remaining they had better be occupied by those who had been in further parts of the room coming forward to see better the contents of the glasses. I enclose a letter which Dr. Sanderson sent to Joseph yesterday, and 3 newspaper notices, one, of Thursday's antiseptic demonstration, the other two of Friday's physiological one. It has been a very successful meeting."

The demonstration, or rather the two demonstrations, on antiseptic surgery had been given on previous days, and had filled the large operating theatre, holding 400 or 500, at a very early hour in the morning.[1] They consisted in the exhibition of a number of surgical cases, such as the ligature of the femoral artery with carbolized catgut, the removal of a large mass of varicose veins, and excisions of various joints, which were selected in order to illustrate the various ways in which the antiseptic treatment might be employed under different circumstances.

All he showed them supplied material for serious thought to this large audience of general practitioners and surgeons. He opened a knee-joint before them, putting in drainage tubes in order that they might see exactly how an antiseptic operation should be performed. He brought in a man with ununited fracture of the thigh bone which he had cut down upon twelve days before, and showed them the wound filled with healthy blood-clot and no trace of suppuration. He explained how blood-clot may form a foundation for the growth

[1] *The Scotsman*, August 6th, 1875.

of new tissue, and cicatrization take place, not only without suppuration but without even granulation, and added:

"How the tissue which is thus formed in an organizing blood-clot differs histologically from that of granulations I have not had time to investigate. But that it differs from granulations functionally is certain, and that in two ways. First, it has not nearly the same tendency to contract that granulations have; and secondly, instead of forming pus under the influence of the very slightest stimulus, as granulations do, this tissue resembles normal textures in requiring protracted stimulation to induce it to granulate and suppurate. Now, cicatrization in an open wound without granulation is something new; it never happened in the world's history without antiseptic means."

He also described a new method of stitching up rents in veins, and many other interesting and novel procedures. And from time to time he answered some of the criticisms so often repeated that they were almost accepted as justified.

"It seems to be a difficult thing for me to write the English language so as to make my meaning intelligible. I find the opinion still often attributed to me, that carbolic acid stops suppuration by some sort of specific agency. On the contrary, I have pointed out, from my earliest experience in the subject, that antiseptic treatment threw remarkable light upon the subject of suppuration, by showing that an antiseptic itself, while it prevented putrefaction, stimulated to suppuration; so that you have what I have termed 'antiseptic suppuration,' if the antiseptic continues to act upon the tissues for a certain length of time." [1]

And again:

"I am sometimes accused of taking a deal of unnecessary pains with my cases, and it is also said that any good results which I may get are due to my own personal care. If such were the case, Gentlemen, if I obtained better results than other surgeons by the more careful use of the same means, that would indeed be something to be proud of. But it is not so. It is simply that we are working on a new principle. Mr. Rice, my house surgeon, who was trained first as a dresser and afterwards as a clerk under me, does these things exactly as I do them myself. If I were to go away for a week, a fortnight, or a month, as far as the antiseptic element is concerned, I should feel I had left my patients in perfectly safe hands." [2]

[1] *Collected Papers*, vol. ii. p. 265.

[2] *Collected Papers*, vol. ii. p. 264.

The week spent by the British Medical Association in Edinburgh did much to convince provincial surgeons that Lister was really "working on a new principle," and that a new era in surgery had dawned; but in London the effect was insignificant, and no enthusiasm was aroused.

In the next chapter we shall see how he began to make his influence more felt in London, and to reconnoitre the scene of his future labours.

CHAPTER XXIII

EXPERIMENTS ON ANIMALS. THE GENERAL MEDICAL COUNCIL (1875-1876)

IMMEDIATELY after his return from abroad Lister was forced to take the first of many steps in opposition to the misguided efforts of the anti-vivisectionists, which have seriously interfered with scientific research and education in this country.

The early part of the nineteenth century marks the beginning of that period of Social Reform, for which there was crying need, and the benefits of which we are now enjoying. We are also suffering from the intrusion of enthusiasts of ill-balanced minds who flock to its banner, to whom change is synonymous with reform, and who often do grievous harm to the cause they have at heart, and to others of perhaps greater importance which only interest them because they interfere with their dreams.

Spirit-drinking, cock-fighting John Bull in the eighteenth century was not an altogether lovely character either at home or across the seas. He needed reform. And when once the necessity was grasped he was reformed to the extent of persecution. One of the earliest efforts in this direction—the campaign in favour of total abstinence—reached Ireland from America in 1818; and very soon afterwards the agitation for treating our humbler fellow-creatures with more consideration and kindness led to the foundation of the Royal Society for the Prevention of Cruelty to Animals, in 1824. The work of this Society has in the main been wholly good, and has resulted in the passing of various Acts which put an end to bull-baiting, bear-baiting, the cropping of

dogs, docking of horses, dubbing of cocks and other useless and often thoughtless cruelties inflicted upon domestic animals.

The movement gained force but not always wisdom as it advanced. New societies representing extreme views were started; the word "animal" was made to include bird, beast, fish, and reptile; and then in an unlucky moment, attention was directed to the physiologist in his study trying to solve nature's riddles by the aid of experiments on animals. This was a rare opportunity. Attention was diverted from the more glaring evils so difficult to attack, such as the horrors of the abattoir or the pleasant pastime of the chase. For, unfortunately, enquiry showed that a certain number of physiologists, in less humane countries than ours, had undoubtedly pursued their investigations with cold-blooded callousness. Moreover, the mere fact that these things were done in the privacy of the laboratory raised the suspicion that still more ghastly performances took place than were reported. Suggestions were repeated as fact. The whole race of physiologists were branded as cruel and even revelling in their cruelty, and this infamous accusation was finally levelled at tender-hearted doctors of all descriptions.

Such accusations were easily believed by kindly sentimentalists, who are seldom the most charitable of mankind, but whose votes may turn an election. Denial was useless. Agitation became fierce, and successive Governments have found it increasingly difficult to resist attempts to strangle research by ridiculously stringent legislation.

It would be out of place here to give evidence as to the value and the necessity of experiments on animals for the thorough study of human and animal diseases, and for the advancement of physiology. Our attention is, at present, only directed to the years 1874-1876, and to Lister's part in what took place at that time.

He was never in any doubt himself as to the justifiability and necessity of performing experiments on animals for the sake of eliciting scientific truth. All his early studies had been conducted with the help of such experiments, and he was satisfied that he could neither have carried out his physio-

logical investigations nor a great part of his antiseptic work without their aid.

The actual process of operating on dumb creatures was distasteful to him, and all unnecessary pain was studiously avoided; but sympathy with their discomfort did not prevent him from concentrating his mind on the subject he was investigating.

1874 was the Jubilee of the Royal Society for the Prevention of Cruelty to Animals. On this occasion, by command of H.M. Queen Victoria, Sir Thomas Biddulph wrote to Lord Harrowby, its President, expressing the Queen's anxiety as to the suffering of animals under experiment. "In regard to the pursuit of science, she hopes that the entire advantage of those anaesthetic discoveries from which man has derived so much benefit himself, in the alleviation of suffering, may be fully extended to the lower animals.[1]

In June 1875, Sir Henry Ponsonby, the Queen's private secretary, wrote the following letter to Lister requesting him to make an authoritative statement opposing "vivisection," before the then appointed Commission should have made their report.

"BALMORAL.
June 15, 1875.

DEAR SIR,

You are no doubt aware that a Royal Commission is about to enquire into the subject of Vivisection, but some time must elapse before any legislation is attempted.

In the mean while it is to be feared that the unnecessary and horrible cruelties which have been perpetrated will continue to be inflicted on the lower animals.

The Queen has been dreadfully shocked at the details of some of these practices, and is most anxious to put a stop to them.

But she feels that no amount of legislation will effect this object so completely as an expression of opinion on the part of some of the leading men of science who have been accused, she is sure unjustly, of encouraging students to experiment on dumb creatures (many of them man's faithful friends and to whom we owe so much of our comfort and pleasure) as a part of the regular educational course.

[1] For the text of this letter, see *Report of the Royal Commission on the Practice of Subjecting Live Animals to Experiment for Scientific Purposes*, 1876, p. 325.

The Queen therefore appeals to you to make some public declaration in condemnation of these horrible practices, and she feels convinced that you will be supported by many other eminent Physiologists in thus vindicating the Medical Profession and relieving it from the accusation of sanctioning such proceedings.

Yours faithfully,

HENRY F. PONSONBY."

Lister's answer to this letter deals fully with the subject, from the point of view of ethics. The copy preserved amongst his papers is thus endorsed: "Written not very long after my treatment of the Queen in Sept. 1871. J.L. 16, Oct. 97." Possibly the matter may have been discussed during that week at Balmoral.[1] It is as follows:

"Your letter conveying Her Majesty's desire that I should make some public declaration against vivisection, was placed in my hands on my return from the Continent.

I should deeply regret that I cannot see my way to complying with this request, were I not persuaded that my doing so would not promote the real good of the community, which I know to be Her Majesty's only object in the matter. And I feel bound to endeavour to express shortly the reasons for my opinion.

With this object I can hardly do better than begin by saying that I have myself often performed experiments upon the lower animals, and that, if I have been privileged in my professional career to do anything for the good of my fellow men, more is to be attributed to these experiments than to any other work in which I have engaged. When they were performed without chloroform, as has not unfrequently been the case, they have been done at a very great sacrifice of my own feelings; but the greatness of the object in view has appeared to me to over-ride such considerations.

That man is justified in causing the death of the lower animals for his own advantage is allowed on all hands. Animal food is not indispensable to man, as the example of the vegetarians teaches; yet its use is all but universal, and is indeed abundantly sanctioned by Scriptural authority.

The infliction of pain upon the brute creation is also allowed by all to be justifiable when some important human interest is supposed to be served. If, for example, a valuable race horse were affected with a tumour, not growing from any vital part or causing any inconvenience to the animal, but disfiguring it or interfering with its successful running, I doubt whether any one would be found who would object to a veterinary surgeon being called in to remove the

[1] See page 305.

growth; although the pain involved in the operation would be inflicted, not for the good of the horse at all, but merely for the sake of the pride or purse of the owner. Or to take another more cogent example, which the great importance of the subject compels me to adduce. All oxen and the great majority of our male domestic animals, such as sheep, pigs and horses, have been subjected to an operation involving exquisite agony in its execution, and often severe pain from subsequent inflammation in the wound, the object being to make them more easily fattened for slaughter, their flesh more fitted for human food, or in the case of the horse to render them more patient and docile servants. Compared with practices like these, that which has received the odious appellation of vivisection is justified by far nobler and higher objects; not the ministering to the luxury or comfort of a generation, but devising means which will be available throughout all time for procuring the health of mankind, the greatest of earthly blessings, and prolonging of human life.

When therefore I have had placed before me on the one hand the reasonable prospect of promoting these great objects, and on the other my own unwillingness to inflict pain, I have felt bound to give the greater weight to the former.

Anyone who feels it to be his duty to perform such experiments has the comfort of knowing that the sufferings which he causes are not at all to be compared with those which a human being would endure if similarly treated. With regard to this very important consideration two distinct points have to be borne in mind. First, all physiological experience teaches us that the sensibilities of an animal are less acute the lower it is in the scale of creation. Hence we may be sure that the pain felt by frogs, which are by far the most common subjects of experiment, is really of an insignificant and trifling character. Frogs are closely allied in organisation to fishes; and the manner in which a salmon pulls after taking the fly is of itself clear proof that the sensibility of the tongue and interior of the mouth and throat is utterly insignificant compared with that of the same parts in man. Indeed were this not the true state of the case, it would surely be unjustifiable to engage in trout or salmon fishing, or to catch sea fish with the long line, to which they remain attached for hours together after they have taken the hook. And for those who have no objection whatever to fish being caught in these ways to raise an outcry against scientific experiments upon a few frogs seems to me, I confess, simply ludicrous.

Secondly, with regard to animals such as dogs or rabbits which, being much higher in the animal scale than frogs, are undoubtedly endowed with correspondingly keener sensibility, it is to be remembered that absence of the faculty of reflection in the lower animals,

and the comparatively instinctive character of their mental operations, save them from a great deal of the torment which men endure. They know nothing of the agonies of anticipation which, when surgical operations are performed without anaesthetics, are often far worse than the actual pain caused by the knife. Even during the performance of the experiment the sufferings of the lower animals are as it were of a physical or passive nature; since they have not the ability to reflect on and appreciate the horrors of their situation. And no sooner is the actual pain over than the creature, unable to meditate on what has passed, appears perfectly unconcerned and happy; and the story sometimes told of a dog licking the hand of a physiologist in the course of an experiment, is, if properly regarded, much more striking as a proof of absence of suffering in the animal than of cruelty in the physiologist.

Indeed the term cruelty seems to me altogether misapplied in the discussion of this question. An act is cruel or otherwise, not according to the pain which it involves, but according to the mind and object of the actor. If a father chastises a beloved son for his good, he discharges a duty painful to himself but full of kindness to the child; whereas if he were to use the whip or rod in precisely the same manner for the purpose of torturing the boy, he would be one of the greatest of human monsters. Even the fox-hunter is not commonly regarded as cruel; because the protracted bodily suffering of increasing fatigue combined with the utmost mental torture which a fox can be supposed capable of enduring, not to mention the final act of worrying by the dogs, are not the objects which the hunter has in view, but, if he ever thinks of them at all, are regarded as entirely secondary to the gratification of himself and his friends. But surely those who regard this amusement as justifiable are strangely inconsistent if they brand with the epithet cruel the man who performs an experiment upon an animal at great sacrifice to his own feelings and with every care to render the pain as slight as is compatible with the high object in view. And I am bound to add, in vindication of the honour of my own Profession, that medical men are, as I believe, on the average the most humane class of the community, their whole lives consisting in the practice of beneficence in a form which constantly evokes and educates their best feelings. And whatever may be the case in other countries, I feel sure that the avoidance of needless suffering may be reckoned on with entire confidence in the performance of experiments on the lower animals in Britain.

It is sometimes said that, although such experiments may be needful and right for the purposes of discovery, they are not justifiable for the demonstration of truths already ascertained. It would, I believe, be very wrong to draw any such line of distinction. To take

a single instance; to debar the student of medicine from having his eyes opened to the truth of the circulation by seeing the blood coursing through the vessels of the living web of the frog's foot, would be undoubtedly a mistake: for no amount of verbal teaching could do for him what a glance through the microscope at that sight at once effects.

Demonstrations upon the higher and more sensitive animals are, I believe, in this country always made painlessly under anaesthetics; and this is undoubtedly right, in order to avoid the demoralizing effect that might be produced upon the minds of the class and that of the operator himself by the infliction of needless suffering. As regards the pain to the animals themselves it is in sober truth far from being the principal item for consideration.

That which they would experience in such experiments without chloroform would be often much less than they would endure if left to die in the ordinary course of nature from violence or disease, or from cold or hunger; and all the so-called vivisections that take place in a year in Great Britain would, if done without anaesthetics, cause less torture than may result from the winging of pheasants in a single day's sport on the battue system. But the deliberate infliction of needless pain would have a most injurious influence upon those who caused or witnessed it, and it is therefore of the utmost importance that it should be avoided. This however, as I said before, may be safely left to the humane feelings of those engaged in teaching physiology in our medical schools and those members of the profession whom an ardent desire for the pursuit of truth and the benefit of their fellow creatures may urge to prosecute such investigations as private individuals.

I am therefore clearly of opinion that legislation on this subject is wholly uncalled for; while any attempts of that kind might prove very injurious by checking enquiries calculated to promote the best interests of Her Majesty's subjects."

The Royal Commission which was appointed to enquire into the subject held its first meeting on July 5th, 1875. Lister gave evidence before it on November 1st. He stated that his first experiments on animals had been made when he was "altogether unknown as a person of any sort of reputation whatever."

"When I first took in hand to teach others, I felt that there were some points on which I desired more information than I could get satisfactorily from any book, and my first experiments were performed with the object of preparing myself for teaching, while I was not a person of recognised scientific attainments."

In reply to a question from Huxley, he said that these early experiments on the blood had guided him towards his later work.

" [They] had the effect of giving me a kind of pathological information, without which I believe I could not by possibility have made my way in the subject of antiseptics ; and that subject, I believe, is becoming recognised as one of considerable practical importance. I have often felt that without the basis which I derived from experiments on the lower animals, I should never have been able to thread my way through the very perplexing and apparently contradictory facts which I met with in the first instance."

He was questioned by Erichsen as to his later experiments with the catgut ligature.

Q. Am I correct in understanding that in all your various capacities, as practitioner of surgery and as a teacher of surgery, and also as a man who has been foremost in the advance of surgical practice and science, you have found experimentation on living animals necessary ?

A. That has been so.

Q. And that through the medium of that experimentation, originally commenced possibly, I think I understood you to say, with other views, you were gradually led to the development of that method of treatment which is now known as the antiseptic system ?

A. Yes.

Q. That in the pursuit of that enquiry you were led to ligature the arteries of some of the larger animals ?

A. Yes.

Q. Am I right in thinking that it was necessary that you should discover some substance, to use as a ligature, which did not produce the irritation which is occasioned by an ordinary ligature ?

A. Yes.

Q. That was an essential part of the business ?

A. It was.

Q. And that could only be ascertained by experiments on living animals ?

A. Yes, certainly.

Q. Had you not made experiments on brutes, you would have had to experiment on man ; there was no alternative, was there ?

A. There was no alternative.

Q. You could not discover such a thing as an antiseptic ligature, for instance the antiseptic catgut ligature, by any *a priori* reasoning ?

A. It must be tested by experiment.

As in his letter to Sir H. Ponsonby, he again stated that he thought legislation was uncalled for. Dealing with this part of the subject, the Commissioners said :

" In considering the question of legislative interference, we have found in some minds a decided prepossession against it. This appears to be connected, as in the case of Mr. Lister, with a notion that such interference implies an imputation of cruelty upon those who are engaged in these investigations ; an imputation they are conscious they have not deserved. From this prepossession, as we have already seen, many of those whose position and character entitle them to the greatest weight are wholly free ; and it has always yielded to the consideration that if there be a proved necessity for legislation to prevent abuse, such interference will be right, provided that the teaching of physiology and the prosecution of research by competent persons are not interfered with."

Lister's view, therefore, not meeting with sufficient support, did not warrant the Commissioners, even if they had agreed with it, in advising the Government to take no action ; and they reported in favour of legislation. Accordingly, a Bill was introduced into the Upper House by Lord Carnarvon, May 15th, 1876.

This was the state of affairs when in the early part of 1876 Sir Robert Christison resigned his seat on the General Medical Council, and Lister was appointed in his place. It was the first time since the foundation of the Council in 1858, that one of the five Crown nominees had been a surgeon, and it was a recognition that, next to Christison, Lister was now looked upon as the most prominent medical man in Scotland.

He attended the May meeting, and at once had to take an active part in its proceedings. Mrs. Lister thus describes their experiences in a letter from the Wimpole Hotel, May 24th :

" We arrived yesterday morning. Joseph had agreed before we left home to propose a motion against legislation with regard to vivisection. So his thoughts have been busy. He pondered during

the forenoon yesterday, and then we went for a little walk, and came back in time to meet Professor Turner (of Edinburgh) who fixed to come to lunch at 1. After lunch Joseph and he went to call on Mr. Simon,[1] who has just been appointed a member of the Medical Council, to ask him to second Joseph's resolution. But Mr. Simon thinks it better that he should not take part, and it is decided that Dr. Humphry[2] of Cambridge should second. . . . Joseph went to dine at Hyde Park Gardens with Mr. and Mrs. Arthur Mills (she is Dr. Acland's sister) to meet Lord Sandon, and Dr. Acland.[3] Lord Sandon is Vice President of the Education (what ?, Council of Education ?, Board ?, Commission ?, Committee ?). Joseph also met Mr. Cowper Temple,[4] Sir James Paget, Sir William Gull, Dr. Allen Thomson (of Glasgow), Dr. Wood (of Edinburgh) and some others. I think there were 18 at dinner. . . . Joseph and Dr. Wood walked back together to near this place, and Dr. Wood talked of the formidableness of speaking before the Medical Council,—he spoke of the absence of applause, depriving speakers of the convenient intervals for collecting their thoughts ! and of the critical character of the audience, said it was worse than speaking in the House of Commons ! . . . .

Have you seen the discussion on the 2nd reading of the Bill, in Tuesday's *Times* ? and the *Times'* article on Tuesday ? There was an excellent article in Tuesday's *Standard*—evidently written by a physiologist, showing how physiological research would be almost banished from this country or be illegally carried on if the Bill is passed."

The motion proposed by Lister and agreed to was : "That a Committee be appointed to consider the Bill introduced by the Earl of Carnarvon on cruelty to animals ; and to report to the Council during the present session." Of this committee Lister was appointed chairman.

The following day Mrs. Lister continues :

"I left off here yesterday, and am writing now while Joseph has gone to see Mr. Bright ! to speak to him about vivisection. The

[1] Afterwards Sir John Simon, then and for many years Medical Officer to the Local Government Board.

[2] Afterwards Sir George Humphry.

[3] Afterwards Sir Henry Acland and a close friend of Lister's. He was at the time President of the General Medical Council and Professor of Medicine at Oxford.

[4] Afterwards Lord Mount-Temple. He was at this time Vice-Chairman of the Committee on Education ; best known as the author of the famous Cowper Temple Clause of the Education Act.

Medical Council's Report on the subject is now completed—but only yesterday. Joseph has been much complimented on his chairmanship and on his speaking. Prof. Allen Thomson said that one of his speeches was one of the best he had ever heard. Prof. Rolleston said his speaking would grace the House of Commons. Dr. Humphry and Prof. Rolleston of Oxford have both expressed themselves warmly, the former speaking of him as the surgeon who had probably done more than any one else to alleviate human suffering by experiments on the lower animals, and the latter as perhaps the greatest surgeon since John Hunter."

Altogether it was a time for making friendly acquaintance with influential men, especially in London and Oxford. There was a conversazione given by the Lord President of the Council, the Duke of Richmond, at South Kensington, and a pleasant week end at Oxford with Acland. Lister writes to his brother, June 5th, 1876:

"Dr. Acland's house teems with beautiful pictures and engravings. He is a great friend of Ruskin, Millais and Richmond. On Sunday morning we went to 'University Sermon' at University church. It was preached by Canon Liddon, perhaps the most celebrated of preachers at the present time in England. It was certainly a great treat. As it was Whitsunday, he seemed to have put out all his powers, and the result is said to have been one of the best sermons he ever preached. The church was crammed."

It was a fully occupied Oxford Sunday: Lister and his cicerone strolled through College grounds, peeped at the Science Museum, and attended two more services. The evening was spent with Dean Liddell, then "perhaps the most eminent and influential man in Oxford," whose daughter Alice was "none other than the original of 'Alice in Wonderland,'" and he was shown the manuscript of the little book that describes her adventures.

The report of the General Medical Council bears obvious traces of Lister's handiwork. He was, as we have seen, opposed to any legislation. The Council did not go so far as that, but stated that it was not aware that abuses existed in the British Isles sufficient to justify exceptional legislation, restrictive of physiological study and research. As, however, the Government clearly meant to pass the Bill, the Council wisely suggested several important amendments,

some of which were adopted, others not. For example, in the draft of the Bill the word "animal" was undefined, which gave Robert Lowe, who opposed the scheme with all his caustic logic, the opportunity of dilating on the vivisection of oysters at a feast; the final clause, an apparent afterthought, excludes invertebrate animals, not cold-blooded animals as had been hoped, from the purview of the Act. Thus the frog—"the physiologist's animal"—was left in. It was originally proposed to allow experiments to be performed "with a view only to the advancement, by new discovery, of knowledge which will be useful for saving or prolonging human life, or alleviating human suffering." None would have been permitted for investigating animal diseases, none for the pursuit of pure science. On this point some words of the Report of the Royal Commission were quoted with effect: "Knowledge goes before the application of knowledge, and the application of a discovery is seldom foreseen when the discovery is made."

Lister's endeavours to mitigate the severity of the now inevitable Act were not confined to his efforts in the General Medical Council. A strong memorial was presented by the Medical Faculty of the University of Edinburgh in July 1876, urging upon the Government the importance of the representations of various medical authorities throughout the British Islands, and especially the recommendations of the General Medical Council. In this it is easy to trace his influence, some of the expressions being found almost verbatim in his letter to Sir Henry Ponsonby.

The "Cruelty to Animals Act" received the Royal Assent on August 15th, 1876. It was a compromise between the views of extremists, such as the Earl of Shaftesbury and Lord Coleridge, and those of moderate men like Lubbock, Lowe, Lyon Playfair and W. E. Forster. It had been substantially modified since its introduction. The bonds that had been prepared for scientific workers were to some extent relaxed, and the teachers of physiology began to take a less pessimistic view of the future.

Lister's energy had had a large share in obtaining these relaxations, but his strenuous efforts to have it enacted that

licensed persons might, under special circumstances, be allowed to perform experiments in unlicensed premises were unavailing. He was thinking no doubt of the ligature of the calf's carotid in his father's museum, of an aged donkey which helped him in the cause of science when on a visit to Dublin, of horses at the Veterinary College, and of "glorious midnight hours" when the early stages of inflammation were revealed to him by the circulation in the frog's web. All this would have been impossible if the Act had been in force. It is impossible now. The faddists have had their way. To experiment on animals in this country is now the privilege of specialists and men of leisure. The new idea cannot be put to the test while it is red hot at any hour of the day or night. A possible experimenter must provide himself with accommodation in a registered house and be armed with a license and a certain number of certificates; unless indeed, as Lister and many others were almost forced to do, he goes abroad for the purpose—a poor alternative and one seldom available for a busy practitioner. But the strangest anomaly, as it must appear to our less sanctimonious brethren in the rest of the civilized world, is that our law, while it forbids the granting of a special license to a distinguished doctor to experiment on a chloroformed frog in his own study in pursuit of science, allows anyone who can afford it to hunt a stag to death, or set two greyhounds to course a hare and wager money on the result.

CHAPTER XXIV

EDINBURGH GRADUATION ADDRESS. PHILADELPHIA CONGRESS. INVITATION TO LONDON (1876-1877)

In August 1876 Lister gave the graduation address[1] at a ceremony commonly known in Edinburgh as "capping," at which the degrees are granted, while a venerable black velvet cap is held over the head of each graduate. They are occasions long remembered by the students, and always followed by festivities.

I'm passed, I'm passed,
And capped at last;
I'm qualified and free now,
On pasteboard neat,
Or brass door-plate,
To write myself M.B. now.[2]

He set before them a very high, an almost unattainable standard.

"You must, if alive to the dignity and duty of your office, be satisfied with nothing short of an affirmative answer to the question, Am I clear in my conscience that I bring to bear upon this case as much science and skill as are attainable in the present state of human knowledge? This may, indeed, appear a very high standard; but in direct proportion as we allow ourselves to aim at anything lower, do we degrade our noble profession, and allow medicine to degenerate into quackery."

He then told them that their education was far from com-

[1] *Edin. Med. Journ.* 1876, vol. xxii. pp. 280-284.

[2] The author was Sir Douglas Maclagan.

pleted, and urged upon them the importance of taking another year of clinical work :

" I commonly find that the gentlemen who serve under me at the Infirmary as house-surgeons are, when they enter on their office, pretty confident in their powers in the diagnosis and the treatment of surgical ailments, but grow more diffident and modest, though immeasurably more capable, as their term of service draws towards its conclusion."

Many of his hearers he hoped would do work worthy of publication, but he warned them against the mistake of rushing into print with immature observations in the dread of being anticipated by some other investigator.

" In the first place, the work which he does when his faculties are in their prime of vigour and prompted by youthful ardour, with plenty of time on his hands, will very likely prove, if he does his very best, the most valuable that his life produces. And, in the second place, with a view to his ultimate usefulness, which is the only legitimate ground for publishing at all, a man's early labours are in some respects the most important of all, because by them he has to make his reputation as a trustworthy and able investigator."

Prejudice, he said, was fatal to the pursuit of " the glorious truth."

" In investigating nature you will do well to bear ever in mind that in every question there is the truth, whatever our notions may be. This seems, perhaps, a very simple consideration, yet it is strange how often it seems to be disregarded. I remember at an early period of my own life showing to a man of high reputation as a teacher some matters which I happened to have observed. And I was very much struck and grieved to find that, while all the facts lay equally clear before him, those only which squared with his previous theories seemed to affect his organs of vision. Now this, Gentlemen, is a most pernicious, though too prevalent, frame of mind. When I was a little boy I used to imagine that prejudice was a thing peculiar to some individuals. But, alas ! I have since learned that we are all under its influence, and that it is only a question of degree. But let us ever contend against it ; and remembering that the glorious truth is always present, let us strive patiently and humbly to discover it. And considering that the weakness of our nature makes it often hard for men to recant an error to which they have once committed themselves, you will see an additional reason against rash and premature publication."

And then, after severely criticizing anonymous medical literature, so alluring to "young men who are often tempted by the desire to turn what seems to be an honest penny," he finished with a sentence which, like much that went before, expressed very clearly his views about the difficulties and privileges of the profession of medicine in words familiar to all who ever worked with him.

"Gentlemen, it may seem to you that these imperfect pieces of advice indicate to you that there lies before you a somewhat steep and thorny path; and truly, if we had nothing but pecuniary rewards and worldly honours to look to, our profession would not be one to be desired. But in its practice you will find it to be attended with peculiar privileges; second to none in intense interest and pure pleasures. It is our proud office to tend the fleshly tabernacle of the immortal spirit, and our path, if rightly followed, will be guided by unfettered truth and love unfeigned. In the pursuit of this noble and holy calling I wish you all God-speed."

In September 1876 Lister attended the International Congress in Philadelphia, accompanied by Mrs. Lister and his brother. It was the fifth of these great international gatherings which since then have increased enormously in size and importance, so that the seventeenth, held in London in 1913, was attended by no less than 7,000 members. The Philadelphia meeting was not nearly so large; 480 only were present. Doctors from the continent of Europe had not then acquired the habit of slipping across the Atlantic at a moment's notice as they do now. But it was a great occasion for all that. The year 1876 was a sacred anniversary, for, as a medical journal said, "This Congress was the outgrowth of the Centennium of our nation's history." An Exhibition was being held at the same time, and anxiety was expressed as to what would be "the degree of interest in the meetings on the part of delegates who must necessarily feel the fascinations of the 'Exposition,'" and whether the foreign delegates, "coming robed in the texture of the mature fame of older countries, would assimilate without condescension with the more youthful brotherhood of America."

These anxieties proved to be groundless. The meetings were well attended. The Congress was presided over by the

veteran Dr. Gross, and Lister was one of the heroes of the occasion. He was made President of the Surgical Section, into the proceedings of which he infused much life, taking a prominent part in most of the debates. The Philadelphia correspondent of the *Boston Medical and Surgical Journal* thus describes two of the meetings.

"On the second day of the congress Mr. Lister, by invitation of his section, explained his antiseptic system of dressings, including details of his many experiments upon bacteria. He spoke two hours and a half, was then questioned in regard to details, and spoke another hour. It was rather a doubtful thing for him to do, that is, if he were aware of the amount of time he was occupying. But the close and unceasing attention with which he was followed was not only a fine compliment, but may have been the reason for his prolixity. As a speaker Mr. Lister is ready and comparatively fluent. He is a handsome man, but upon the platform loses in good looks. Compactly built, with ruddy cheeks, side whiskers, and the shrewd, canny eye of a Scotchman, upon the platform he is apparently five feet six inches in height. You are surprised when you meet him to find his actual stature five feet ten inches. He has a laughing face, but his firm mouth and bright eye give it character. Modesty is stamped upon his every act and word, but he *does* believe in antiseptic surgery." [1]

This, though inaccurate, is graphic and good Americanese. So is the following description of a hot debate on a long disputed question whether coxalgia (hip-joint disease) is constitutional or due to injury. Gross, the polished Philadelphian, held the former view, Sayre, the roughest of rough diamonds, from New York, maintained the opposite, while Lister said that whether the disease was constitutional or not had no bearing on treatment.

"Fancy a tilt between Gross and Agnew of Philadelphia, Lister of Edinburgh, Adams of London, Hingston of Montreal, Brodie of Detroit, Moore of Rochester, and Sayre of New York, and other lesser but not less earnest men! These gentlemen used no buttons to their foils. Thrusts were given in earnest. Finally it was found that Professor Gross, who led one side of the debate, would admit that although a child with coxalgia *must* have a strumous constitution, yet his ailment might be lighted up by some slight injury; and that Sayre, who was all on fire in support of his paper and as leader of the

[1] *Boston Med. and Surg. Journ.* 1876, vol. xcv. pp. 366, 367.

opposition, would allow that while in the majority of his cases there was no strumous taint, yet it might be present. Whereupon Mr. Lister, with a quiet smile, said, 'Gentlemen, you do not seem to be far apart. I think you may easily harmonize'; and the discussion ended."

It is needless to say that the social element was well looked after by the hospitable Americans. None know better how to offer a tactful and warm welcome. A grand dinner closed the scene, with Lister on the president's right, supported by General Hawley.

Probably the statement made at the time was true, that this congress opened a new era in American medicine, partly because foreign delegates found "that the American physician possesses higher attributes than they had anticipated." As regards antiseptic surgery, it is not denied that Lister's visit stimulated the first serious attempt to carry it out systematically. As might be expected, with such practical people, a high degree of efficiency was soon reached, and at the present day Lister's is a name to conjure with in the States, any details as to his life or work being listened to with the greatest eagerness.

They had crossed in the "Scythia," a famous Cunarder at that time, which with all sails set and a favouring breeze made 14 or 15 knots, but in a sudden squall split her maintopsail before it could be furled; and a fortnight had been spent in going up the Hudson and across Lake Champlain to Quebec, and in visiting Montreal, Toronto, and Niagara, before reaching Philadelphia.

After the close of the Congress a flying expedition into the west enabled the party to see something of the Rocky Mountains, San Francisco, and Salt Lake City. They returned by Chicago, where grain-lifts and pig-curing occupied their attention to the exclusion of medicine. Leaving the middle west they came to Boston. Here Lister met Bigelow, and received a great ovation on being introduced to his class. The same reception was given him in New York, where he yielded to the request, commonly made in the States, that he would perform an operation before a crowded audience of students and doctors. It was hardly worthy of being called

an operation—merely the opening of an abscess—but it was a useful practical demonstration, and doubtless did much to promote the adoption of antiseptics in New York, where already some earnest men had met with considerable success.

Thus ended, about October 12th, one of the more important of what may be called Lister's evangelistic journeys.

1877 was the year of Lister's fiftieth birthday. In the public eye and that of the medical profession at home and abroad, he was completely identified with Edinburgh. His early expectation of coming to London seemed unlikely to be realized, and indeed to be less desirable as the attractiveness of his position became more pronounced. The true Scotsman, however much he may praise the land of his birth, tends to "haud sooth"; the true Londoner, however loudly he may extol the virtues of the provinces, knows in his heart that there is no place like London. Lister was no Scotsman, though he admired the Scotch and their ways, and if he occasionally hankered after his native city, it was because he was a Londoner at heart, and wished to extend his influence there. Possibly the two sessions of the General Medical Council may have made him ask himself what he would do if the unlikely opportunity of coming to London offered itself. In the meantime, nothing of the sort occurred to disturb his peaceful life in Edinburgh, where he continued teaching his huge class, instructing the many foreign surgeons who visited his clinic, and working out the details of the antiseptic treatment.

A note to his brother, dated January 21st, 1877, indicates the stage which had been reached in this last respect, and shows that his existence was not forgotten in London. After referring to some observations on fungi, it continues:

"My elbow cases that I told thee of are very satisfactory, and in other respects also antiseptics are working very pleasantly.

I am still not quite at the end of the catgut! [not by any means, as the reader knows]. The spray too, has been considerably improved since I returned. I think *that* may now be considered satisfactory.

Dr. Murchison, the newly elected President of the London Pathological Society, has written begging me to give them an evening during his term of office; and I have agreed to make it the 3rd of April. . . . He promises me a 'brilliant reception.'"

This invitation of Murchison's was a sign of the times. No previous suggestion had been made that Lister should address a London audience. Now it came, not from a body of surgeons, but from the Pathological Society, one of the two vigorous offshoots from the sombre old Royal Medical and Chirurgical Society.

The promised address was not given till the following winter session, the occurrences of the next few weeks having made the fixture for April inappropriate and almost impossible.

On February 10th, 1877, Sir Wm. Fergusson died. Thirty-seven years before, when King's College was a young institution, he had been called from Edinburgh, at the early age of thirty-two, to succeed Sir James Arnott on his retirement from the Chair of Systematic Surgery. In 1870 Fergusson had given up the systematic chair and was succeeded by Mr. John Wood, after which, that is for the seven years before he died, he had held the appointment of Professor of Clinical Surgery. In the dearth of students at that time at King's College, this was almost a sinecure, although, according to the calendar, Clinical lectures were given four times a week by the physicians and surgeons.

Fergusson had had a great career. Tall, of striking appearance and an extraordinarily brilliant operator, he was said to have the eye of an eagle, the heart of a lion and the hand of a lady. He had devised new operations and written books. After some opposition he had reached the highest position at the Royal College of Surgeons, and though very, very Scotch, he had been a favourite with the London public and a *persona grata* at Court. But he was a surgeon of the old style, and as he was, moreover, slow of speech and an indifferent lecturer, he was no more able than his distinguished colleagues to attract a large number of students to King's.

King's College was severely handicapped in its rivalry with the other medical schools. Founded originally by mem-

bers of the Church of England, as a protest against the "godless College in Gower Street," as University College was unkindly called, it naturally appealed to a limited number only of the community. University College asked no question about creeds, either of teachers or students, and its lecture rooms were full. King's College was essentially orthodox and in consequence the school, though select, was small. But as many of its most brilliant alumni could not subscribe to the thirty-nine articles, they deserted their Alma Mater, seeking appointments elsewhere. It was therefore no uncommon thing for the staff to be recruited from outside.

It is not surprising that the Medical Committee should have thought of retrieving their fortunes by inviting some very distinguished surgeon to take Sir Wm. Fergusson's place. It is equally not surprising that the project did not meet with the approval of Mr. Wood, then in his fifty-third year, who had been waiting for the reversion of Fergusson's position just as John Marshall had been waiting when Lister attempted to storm the citadel of University College in 1866.

John Wood was in many ways the opposite of Fergusson. He was below the middle height, and attracted notice by his massive frame, square dark face, and piercing black eyes, and by an obvious lameness caused by an old injury to the hip. His abrupt manner, harsh voice and broad Yorkshire accent made him an unattractive speaker, and were rather alarming to students at examinations. These points—minor points it may be said—possibly may have influenced the Medical Committee. But the fact had to be faced that Wood was a considerable anatomist, a sound surgeon and a good operator, who had done some excellent work, and according to London custom had a vested interest in this inheritance.

It was at all events decided to communicate with Lister, but it is uncertain who were responsible for the decision or to whom the task of writing was entrusted. The negotiations were not managed cleverly and led to unpleasant results. The known facts are these.

Very soon after Fergusson's death some "unauthorized person," probably Sir William Bowman, made a proposal to Lister the nature of which was not disclosed, and on

February 18th Lister wrote a letter expressing his willingness to accept the Chair of Clinical Surgery, provided the offer was made to him with conditions which would have involved a radical reform of the teaching there. But, as he said in writing to me the same day, "I think it very likely that such conditions will be considered too strong, and that therefore no offer will be made to me. If such be the case I shall be well content; for the report in the *British Medical Journal* has elicited expressions of kindness here that make me feel more than ever how much good I should be running away from."

The report in the *British Medical Journal*, to which he alludes, drew from the *Lancet* obviously inspired statements that all rumours were premature, and that no offer could have been made, as the Council had not yet considered the matter.

Meanwhile the rumours were sufficiently ominous to disturb the peace of mind of the Edinburgh students, who became alarmed at the thought of losing their beloved teacher. A complimentary memorial was drawn up begging him to remain; about 700 signatures were quickly obtained; it was magnificently bound in scarlet morocco and presented to him by the class on February 22nd.

"We the undersigned Students of Medicine in Edinburgh, learning that there is a prospect of your being asked to occupy the vacant Chair of Clinical Surgery, King's College, London, hasten to express our deep regret that there should be any possibility of the severance of your connection with us. We eagerly seize this occasion to acknowledge the deep debt of gratitude we owe for the invaluable instruction we have derived from your Clinical Teaching. We rejoice that under your tuition we have enjoyed unrivalled opportunities of gaining a thorough insight into the principles of that art to which we have devoted ourselves.

Your self devotion to the advance of Surgery and the indomitable energy which has characterised your search after, and conquest of the causes of those deplorable disasters, once, and even now, unhappily so frequent a sequel to surgical operations, have given to us a mental impetus for good the effect of which it is impossible to over-rate. Inspired by your example many have gone forth, and many will still go forth, determined to carry your principles into practice and spread far and wide the beneficial effects of that system of Surgery of which you are the Founder.

The recipient of the great inheritance of the Chair of Clinical Surgery in the University of Edinburgh bequeathed by your predecessor the illustrious Syme, you have not only upheld but extended its great reputation, increased the ancient prestige and glory of our Medical School, and attracted to it a number of students quite unprecedented in its history. The welfare of our School is so intimately bound up with your presence that its withdrawal must be an irreparable loss not only to it but also to all of us, who would thus mourn the loss of a highly esteemed and greatly beloved teacher. We are far from disparaging that field to which you may be called, but we would venture to submit that nowhere will you find a more numerous and devoted band of followers than those who now count it their greatest privilege to listen to your teaching. While we entirely disclaim all idea of interfering with that which you alone have a right to decide, we would yet earnestly hope that you may long remain in that position you so greatly adorn and that the day may never come when your name will cease to be associated with that of the Edinburgh Medical School."

The occasion was an enthusiastic one, and Lister, whose mind was full of the possible chance of effecting a radical change in the teaching of clinical surgery in a London school, took the opportunity of contrasting, at some length, the clinical professorships in the two cities. In doing so, he said :

" But if I turn to London, and ask how instruction in clinical surgery is conducted there, I find that, not only according to my own experience as a London student, which I once was, but also from the universal testimony of foreigners who visit there, and then come here, it is, when compared with our system here, a mere sham.... The magnificent opportunities of demonstrative teaching presented by clinical surgery are, to a great extent, neglected." [1]

Unknown to Lister, a reporter was present, and the impromptu speech, intended only for the privacy of the class-room, appeared next day in the Edinburgh and London papers. The short report in the *Times* of February 23rd said :

" To-day Mr. Lister, professor of Clinical Surgery in the University of Edinburgh, was presented in his class-room in the Royal Infirmary with an address signed by about 700 students of medicine in Edinburgh, expressing their deep regret that there should be any possibility of a severance of his connection with them, as they had learned

[1] *Lancet*, 1877, vol. i. p. 476.

that there was a prospect of his being asked to occupy the vacant chair of Clinical Surgery in King's College, London. Professor Lister, in reply, said that he had not the remotest idea of accepting in its present form the appointment which had been offered him. He considered the system of teaching in Surgery in Edinburgh much superior to that pursued in London."

This, and a paragraph in the *World*, attracted considerable notice and some sharp comment. The London surgeons were naturally irritated and perhaps not unnaturally mistook Lister's meaning. Indignant letters were written to the *Lancet*,[1] assuming that the criticism had been directed against individuals, and not, as was obvious from the actual words, and still more from the context, against the system under which they worked.

This drew from Lister a long and temperate reply, in which he freely admitted that certain of his words, if read apart from that which preceded them, and without considering the circumstances in which they were uttered, might well excite amazement and indignation. He expressed astonishment that his remarks had been supposed to be applied to individual teachers "with whom it would be as presumptuous as it would be offensive for me to challenge a comparison." He said he would not again use the word "sham," as one of his critics had pointed out that Johnson speaks of it as a low word, but he reiterated his opinion that a distinct chair of Clinical Surgery, such as was common on the Continent, but in Great Britain only existed at Edinburgh and at Glasgow, was far superior to the almost honorary appointments commonly shared in London by several members of the staff, who gave only occasional lectures and at irregular intervals.

The *Lancet* was "not in the least affected by the main argument of his letter, which," it said, "besides being one-sided and inconsistent, is wholly irrelevant." It therefore stuck to some comments made in a previous number, which show what some people thought of Lister generally and of this incident in particular. The following words had been used:

"But his elation would not suffer him to stop even there, for, like a man who in the excitement of enthusiasm raves at the false

[1] *Lancet*, 1877, vol. i. p. 367.

creations of his heat-oppressed brain, Mr. Lister fancied he saw in his professional *confrères* in London only unsubstantial shades and showy shams." [1]

And further on:

" In many quarters Mr. Lister has acquired the reputation of a thoughtful, painstaking surgeon, and has done some service to practical surgery by insisting on the importance of cleanliness in the treatment of wounds, although this has been done by the glorification of an idea which is neither original nor universally accepted; but even these circumstances do not warrant him in arrogating to himself the right to sit in judgment on his fellows, and publicly denounce as impostors those who have the misfortune to differ from him."

A few days before these occurrences (*i.e.* on March 20th), another address had been presented to Lister entreating him to stay. To this were attached the names of 230 medical practitioners who had at one time or another been his students. This time it was a very private affair in his small room at the Hospital. Reporters were carefully excluded and the whole state of things was fully but confidentially explained.

On March 31st, another inspired paragraph in the *Lancet* appeared to suggest that the offer had been withdrawn. It thus summed up the situation:

" It is well known that immediately after Sir W. Fergusson's death, some one officiously undertook to invite Mr. Lister to occupy the vacant chair of Clinical Surgery, but it now appears that this unlawful negotiation has failed. When Mr. John Wood, who had for many years lectured on Systematic Surgery, was recently appointed to the chair of Clinical Surgery, Mr. Lister was, we believe, asked to take the Professorship of Systematic Surgery, but declined, expressing at the same time his willingness to undertake the course of instruction in Clinical Surgery, and it was thought that some arrangement could be made whereby he might share the course of Clinical Surgery with Mr. Wood. To this Mr. Wood strongly objected, and as Mr. Lister, in his letter this week, seems to condemn the appointment of two teachers of Clinical Surgery in one school, it is probable that he will not now come to King's College."

For a time indeed it was evidently thought that the matter was decided, as appears from the following letter which Lister received from Sir Thomas Watson, the well-known

[1] *Lancet*, 1877, vol. i. p. 361.

physician, who was a member of the Consulting Staff of King's College:

"REIGATE LODGE,
REIGATE,
SURREY.

Good Friday,
1877.

MY DEAR MR. LISTER,

I was meditating a note to you when your letter reached me yesterday in London. I wanted to say how deeply mortified I am that, after all, you are not to adorn and benefit our College and Hospital by exercising among us your great mission of safety and mercy to mankind.

Diis aliter visum. I must content myself with the personal consolation of having gained your acquaintance and with assuring you that I esteem that privilege very highly.

That what has occurred will not prove injurious to King's College I cannot believe. It must be a misfortune to all of us.

Wherever you may be, accept my cordial wishes for your health, prosperity and happiness, and believe me to be

dear sir,
Sincerely yours,
THOS. WATSON."

Negotiations were however renewed and carried on with great activity during the May meeting of the General Medical Council. They culminated in the decision of King's College to create an additional Chair of Clinical Surgery for him. Lister's conditions were agreed to and he was elected on June 18th. The attendance on a course of Clinical Surgery was made obligatory, and it was arranged that he should not have to share his wards with a colleague. This involved increasing the number of beds in the hospital from 172 to 205, constructing a new ward and opening another which had been closed for many years.

Surprise has often been expressed that Lister should ever have contemplated leaving his splendid field in the northern capital—the large Infirmary, the unrivalled class of enthusiastic students, and the settled affection of his Scottish friends—in order to take up a secondary position in a comparatively small London hospital, where the average annual entry of medical students was less than 25, whereas that in the University of Edinburgh was over 180. It might at least have

been expected that he would have given up the troublesome quest, when he saw what stormy waters had to be crossed before reaching port, and thought of the uncertainty as to the kind of welcome awaiting him.

But it is not difficult to account for his perseverance. There was no need to expect a cold reception. A wrong impression may perhaps have been conveyed by dwelling hitherto almost exclusively on the views and words of the operating surgeons. But surgeons represent only a small minority of the medical profession. There are at least an equal number of physicians, a large army of general practitioners, and a select body of the followers of pure science, most, if not all, of whom would be sure to welcome him with open arms.

And, after all, the doctors form but a fraction of the population. Lister had a considerable number of English acquaintances outside the profession, who had heard of his growing fame and were jealous of his being completely identified with Scotland. These strongly impressed upon him their conviction that London was his proper sphere and urged him to make the move even at some sacrifice. If he came to London, therefore, he would find himself amongst friends.

Had he thought of his diminished influence owing to the probable small size of the class, he would have been justified also in reflecting that on each of his previous migrations he had at once inspired life into the school, attracted more students, and quickly obtained their cordial affection. Possibly in his mind's eye he saw the theatre at King's College packed with eager listeners from top to bottom. When he was a youth at University College there was no lack of numbers or enthusiasm. Why should it be different at King's? Moreover Lister had always taken a deep interest in medical education, and held very definite views on many educational questions, which he knew to be at variance with those which commonly found favour in London. He probably welcomed the prospect of making them more widely known. Amongst them was the firm conviction that the material for surgical clinical instruction in London, admittedly the best in the world, was to a large extent wasted, and that the Edinburgh

system of clinical instruction was far superior. Here then was a chance, by practical demonstration of this superiority, of persuading others to follow his example.

But there was a stronger, indeed an overpowering argument in favour of the move. Lister was now a man with a mission. The antiseptic doctrine had been accepted in every part of the world that counted, except London, where alone it made but little way. The importance of converting the greatest centre of learning and education in England justified almost any sacrifice, and it seemed as if the only way of convincing Londoners were to let them see how he actually carried out the treatment himself, and the results he was able to obtain.

And, beside these special considerations, there must have been in the background of his mind, perhaps not consciously thought of, the attraction of London itself, powerful in spite of the many drawbacks of the great city. They cannot be better put than in the half serious, half humorous words of Dr. John Brown. Mrs. Lister was a great favourite of his, and he wrote to her on March 29th, 1877, when it was thought that the negotiations had been definitely broken off :

" 23 RUTLAND SQUARE,
EDINBURGH.

MY DEAR OLD AGNES,

Thank Josephus the Victorious for his goodness in writing me, with all his work and him so fond of writing! He has done nobly and, in the true old Latin sense, *Virtuously* and as few men in his shoes would have done. It was no small temptation that He (for of course it was the Devil) held before his eyes. The Kingdom of the world and the glory of it—Kings and Queens and Lords and Ladies and £15,000 a year (at least) and a Baronetcy and Westminster Abbey —by and very far by—and his own City the head and heart of the world and his own people! it was not an unsplendid bait—but as he (and as the beloved friend who is gone knew) knows, there is another and a dark side.

Goodbye, my dear two—made for each other and for our good.

Ever affectly

J. BROWN."

An account of Lister's life in Edinburgh would be incomplete without some reference to his great interest in the management of the University, which will incidentally help

to explain what has been already said with regard to his views on medical education. On many points these were remarkably clear and strong, so that he felt bound to take an active part in the proceedings of the Senatus Academicus, of which, as a Professor, he was a member.

This body, up to 1889, were not only the directors of the educational and disciplinary arrangements of the University, but also were entrusted with the responsible duty of administering its finances. Many of the Professors felt that they had no gifts or no relish for these things, and left them to their more conscientious or more business-like colleagues. Lister, who had received a good training at Glasgow, attended the meetings regularly, but few of the subjects dealt with in which he took a prominent part were of any general interest, except that of vivisection.

Amongst them, however, was that of the "one portal system." The Medical Act of 1858 was disfigured by one notable blot. It provided that a single qualification, medical or surgical, should admit to the Register. Thus it was possible to obtain a license to practise by passing a single examination which only tested the candidate's knowledge in one branch of medicine. The General Medical Council, following the lead of the London Royal Colleges and the English Universities, proposed to remedy this defect by what was known as the "one portal," or in Scotland as the "one board," system. There was to be one examination for the whole kingdom (or three uniform examinations, one for England, one for Scotland and one for Ireland), which every doctor would have to pass before he became qualified, whatever academical distinctions he might desire to obtain in addition. The examination would test his proficiency in medicine, surgery and midwifery. This project, which, whatever may be said to the contrary, would have certainly protected the public from imperfectly educated doctors, has never been carried out, partly because of the opposition it met with in Scotland, where indeed it was less needed than elsewhere because two thirds of the Scottish students became graduates of their universities. Lister was a supporter of the Scottish view in the Senatus.

In another much debated question which was discussed by the Senatus at this time he was a powerful supporter of the Scottish as opposed to the London opinion. The General Medical Council and the London Corporations have always held that a candidate should never be examined by his teachers. This was called "branding your own herrings." In Scotland it was equally strongly maintained that the teacher should at least be present at the examination even if he took no active part in it. The English plan was said to be unfair to the students. A strange examiner might well be unacquainted with what the student had been taught, medicine being an inexact science and capable of many different ways of presentation. Moreover, an outside examiner can seldom make allowance for nervousness, which, though usually a sign of ignorance, is often a genuine result of the dreadful ordeal the student is passing through. This the teacher may be justified in taking into account. There is much to be said on both sides of the question. Lister never doubted the superiority of the Scottish plan and fought strenuously for it after coming to London, where however his arguments failed to make any impression.

When the King's College appointment was announced, the end of the session was approaching. Later the University of Edinburgh gave him an honorary degree, but there was no formal farewell, no public dinner or demonstration of any kind. He made his last visit to the hospital in the usual way before his summer holiday, saddened by the melancholy knowledge, which was shared by the group of students who accompanied him, that his place would know him no more.

Thus ended the great period of the Professorship of Clinical Surgery in Edinburgh, which had started with the beginning of Syme's incumbency forty-five years before.

The class has never been nearly so large since Lister left. To account for this it must be borne in mind that while all students are obliged to take out a course of clinical surgery, they need not necessarily attend that of the Regius Professors. Students in Edinburgh were apt to divide themselves into opposing camps. Some might be followers of Syme or Lister :

others might profess to disbelieve in them, but none would be so foolish as to lose the chance of a lifetime, by refusing to attend the teaching of such outstanding personalities. Excellent surgeons have in turn succeeded them, but they have not been men of the same calibre. The students therefore gave way to that healthy eclecticism which is a characteristic of the Edinburgh school, and the Chair has consequently lost something of its importance.

If Lister's presence had been advantageous to the University, his nine years in Edinburgh were of priceless value to him. No place in the British Isles could have provided him with such a class, or such good opportunities for pathological and clinical research, or for spreading his influence amongst foreigners. He never forgot the debt which he owed to Edinburgh or ceased to regret the end of that which, notwithstanding all the important things that happened in London afterwards, must be regarded as the most brilliant and probably the happiest period of his career.

CHAPTER XXV

EARLY DAYS IN LONDON. INTRODUCTORY ADDRESS AT KING'S COLLEGE. ADDRESS TO THE PATHOLOGICAL SOCIETY

(1877)

THE first thing to be done on coming to London was to decide where to live. Many houses were looked at both in and outside the recognized consultants' quarter, then almost limited by Harley Street and Wimpole Street to the north, Savile Row and Old Burlington Street to the south and, for the more ambitious, reaching westward into the fashionable purlieus of Mayfair. All these seemed cabined and confined, compared with an Edinburgh Square, and at last No. 12 Park Crescent was fixed upon. Many brass plates now adorn the mansions in Portland Place, but at that time they were specially forbidden in the leases and, although one enterprising dentist had for long indicated his presence by his name inconspicuously printed round the bell-pull, few attempts had been made by doctors to invade this aristocratic region; and no consultant had even dreamt of Park Crescent, which was looked upon as almost suburban. The medical world shook its head. Lister would never get any practice there. But for him it had two advantages: one, that the Park Crescent and Park Square Gardens were close at hand in which to meditate, while the more secluded Botanical Gardens were within a stone's throw; the other, that by going there he clearly showed his intention not to put himself obtrusively forward in competition with the London surgeons.

Lister's private practice in London became considerable, but never really large, as compared with large surgical practices

even of that day. It had its special characteristics. Patients were sent to him from all parts of the British Isles, indeed from all parts of the world, in order that they might be treated antiseptically. A certain number of the older and more influential London surgeons who were themselves not eager to operate,—whose operating days were perhaps over,—from time to time brought serious cases to him for the same reason. And from this point of view his advice was often sought by consulting physicians. The London general practitioner, though as a rule faithful to his teachers, is often an eclectic, and likes to make up his own mind by personal intercourse about any new luminary who appears. It was so in Lister's case; he attracted a number of faithful adherents, not a few of whom came from Scotland. But some things militated against his becoming a great favourite with doctors. One was his unpunctuality. Another was his preference for leaving the amount of the fee to the discretion of the patient: a custom of Syme's founded on the assumption that a fee is an honorarium and not a payment for work done; the outcome of which was that, whereas in rare instances the sum accepted appeared to be excessive, it was more often ridiculously small: in either case the doctor was made to look foolish if the patient had consulted him on the matter beforehand. Another obstacle to a large practice was that he could not with a clear conscience trust the after treatment of operations to the general practitioners, who had been accustomed to look upon this as their function, it might almost be said as their privilege, but who in nine cases out of ten had not the smallest notion how to manage a case antiseptically.

For personal supervision over his patients, the private nursing home offered great advantages. In 1877 there were only one or two such homes in London. The idea was new, and as one of the first to be started, No. 15 Fitzroy Square, was conveniently near to Park Crescent, Lister at once availed himself of it. For years his patients occupied the greater number of its rooms, and his morning visit there was part of the ordinary daily round. But it was long before the public recognized the advantages of nursing

homes; and yet longer before the family doctors ceased to complain that in nursing homes patients were removed from their observation at the most interesting and critical stage of the disease. It must be owned that the earlier homes were far from perfect, and they were followed by smaller and less well managed institutions which justified the objections of the public and the general practitioners. Thus many more operations were done in private houses than is the case to-day. But even under these circumstances Lister did not hand over the dressing to the family doctor till all danger from sepsis was past. As time went on and the urgency of scientific enquiries and other matters made him very busy, this duty devolved almost entirely on one or other of the young surgeons who assisted him,[1] so that some outlying patients were hardly seen by Lister himself from the day of the operation till the removal of the last dressing. This arrangement impressed different people in different ways, but on the whole probably tended somewhat to limit his private practice.

He was however quite content. A larger and more exacting practice would have been intolerably irksome to him, but, on the other hand, a smaller one would have been disappointing. Lister valued the human element in private practice, and took the keenest personal interest in his patients. They, in their turn, regarded him with veneration, and a considerable number became his personal friends. Besides, he fully recognized the invaluable lessons which may be learned from intelligent family doctors, and the necessity of personal experience of the difficulties of private practice for one who is engaged in preparing students for this as their occupation in life. He also prized the opportunity which private practice offers for observing every detail in the process of healing, and which hospital practice can scarcely yield.

He would have been as much opposed to any suggestion that the Professor of Surgery should be prevented from engaging in private practice, as he was to the proposal that the Professor of Pathology should no longer have beds in

[1] Most of this duty devolved upon me in the early days; a part of it on Watson Cheyne, who shared with me the privilege of assisting Lister during the whole of the time he practised in London,—till, in fact, we were both on the senior staffs of our respective Hospitals.—R. J. G.

the hospital—that he should, in fact, lose touch with the manifestations of disease during life, and be confined to the mere study of morbid specimens in his laboratory. The first of these questions had not then been mooted, the second was already being hotly debated. In regard to both, Lister was opposed to the more modern views, imported from Germany, which fortunately have as yet been only in part accepted by or imposed upon the profession in this country.

Lister had stipulated that he should be allowed to bring with him from Edinburgh four men whom he had himself trained, to form the nucleus of his staff at the hospital. Two were graduates: Watson Cheyne, now senior surgeon to King's College Hospital, and John Stewart, of Halifax, Nova Scotia, whose graphic pen has drawn many life-like pictures of the master to whom he was deeply attached; the other two were unqualified, W. M. Dobie and James Altham, who afterwards practised at Chester and Penrith respectively. These were good men and true, firm believers to whom the care of the wards might be entrusted with confidence. Cheyne was house-surgeon, Stewart senior assistant or clerk, and the other two dressers. Without such assistance it would have been almost impossible to plant his new system in the uncongenial soil which was the best that King's College Hospital was able to offer him.

Even in connection with the nursing department there was a grievous amount of friction. The reformation of nursing in London had not yet reached maturity and the defects of its qualities were apparent and often galling. Sisterhoods became veritable *imperia in imperio*, armed with a code of inflexible rules to which not only patients but medical officers were expected to submit. King's College was not the most fortunate of the hospitals in this respect. Two extracts from a letter of John Stewart, who in due course had become house surgeon, will show how this affected the emigrants from the north where the spirit of the old regime still to a large extent survived.

"To us, coming from the Royal Infirmary with its simple, kindly, common sense routine, in which the patients' welfare and comfort

were the first consideration, this cold machine-like system was intolerable. I shall give you two instances. One afternoon as Lister was about to leave the hospital Dr. Duffin asked him to see a boy in his ward. . . . Lister soon satisfied himself it was a case of osteomyelitis of the femur and advised immediate operation. While some of us proceeded to get things ready in the operating theatre, I went with others to have the patient removed. The porters were off duty, or could not be found. It was not the custom at King's, as it was in Edinburgh, for the students to carry patients to and from the theatre, and I recollect there was delay in getting a stretcher. When we arrived at the lad's bedside the sister in charge told us we could not be allowed to remove him. Why? Because no patient could be removed without a permit from the Secretary! I pointed out the fact that the Secretary had now left the Hospital and would not be back until 10 a.m. next day, that Dr. Duffin himself and Mr. Lister were now in the theatre waiting for the patient and had decided that immediate operation was the proper treatment. All was of no avail. I lost patience and proceeded to wrap the unconscious boy in his bed-clothes in order to place him on the stretcher. But the sister and the nurses adopted so resolute, and, I may say, so menacing an attitude that all of my dressers fled—except Addison, who held the ward door open while I walked out with the patient in my arms, the nurse actually pulling at the bed-clothes in an attempt to *rescue* the patient. I carried him to the operating theatre and he was then our property. It was a serious case . . . but the lad got well."

The other extract is interesting also from another point of view, for it illustrates a new feature—it may be said a new difficulty—in hospital practice, which resulted from the introduction of the antiseptic treatment. Chronic cases of tuberculous disease of bone, complicated with abscesses, formerly almost invariably fatal, became curable; but only by very prolonged and scrupulously careful treatment. To send them back to their homes before healing was complete was practically to send them to their deaths, or at best to condemn them to years of misery. But there was a danger of the wards becoming filled with such chronic cases to the exclusion of the more interesting and some would say more important acute cases.

Hospital managers could not, of course, appreciate the change which had been brought about, and surgeons were sometimes disposed to shut their eyes to it. Lister, however,

said that he never allowed a patient to be discharged from his wards when there was a chance of this dreadful result following.

In October 1877 the managers of the Edinburgh Royal Infirmary decided to discharge some of these chronic cases which Lister had left behind.

" There were, I think," says Stewart, " six men and boys, and one woman, a very nice girl, and a great favourite on account of her cheerful patience. She had been admitted on August 1st, 1876, with a large psoas abscess, and was still in bed in October 1877, but looked the picture of health, with rosy cheeks. Mr. Caird [1] wrote to me, and I told Mr. Lister. I remember how his look of incredulity changed to one of sorrow and honest anger, and he used the strongest expression I ever heard him utter. He said, ' It's an infamous shame ! ' "

Lister agreed to admit Lizzie Thomas, the patient with the psoas abscess, to King's College Hospital, and she was brought up to London by the head nurse, in one of those baskets which were used in Edinburgh for moving patients between the wards and the operating theatre.

" It was a cold bleak morning in the end of October. The porter helped us in with the basket and its contents, and then we had to lay it down while the porter went to notify the ' Sister in charge.' He was gone for some time, and came back, looking very much perturbed, and reported that the patient could not be admitted without proper admission papers ! There we stood, very foolish-looking, all but the patient with her brown hair, blue eyes, rosy cheeks and cheerful smile. [The Scotch nurse] doubtless had her own reflections, *not* to the advantage of London. I ran upstairs and saw the Sister, who reproved me loftily for my irregular behaviour. It was in vain that I pled ignorance of rules, that I asserted I had Mr. Lister's permission to admit the patient, that I thought the rules might be relaxed in the case of this patient who had been travelling all night and was tired and cold. I was told she could not be admitted until the Secretary came and drew up the papers. That would be 10 a.m., over two hours !

I came downstairs. I was too angry to see the comic side of the affair. Vaughan the porter, an old Crimean soldier, stood dubious and perplexed. I said, ' Now Vaughan, an old soldier like you can't stand and see a pretty girl lying on this stone-cold floor, give us a

[1] Then Assistant-Surgeon to the Royal Infirmary and Extra-mural Lecturer on Surgery ; now Professor of Clinical Surgery.

hand.' He flushed, and saying 'I will, sir, if it costs me my place,' took a corner of the basket and we carried Lizzie upstairs and down the corridor to my ward, where I demanded admission for my patient. One of the Sisters placed herself in front of the closed door to bar the way. Others asked if I were not ashamed of my scandalous conduct. I said I was not, but there would be a scandal very shortly if they did not take my patient in and put her to bed, as otherwise we would take her in and put her to bed ourselves. I suppose I looked as roughly as I spoke, for resistance gave way and the poor girl was put to bed. But she was a 'speckled bird' for many a day.

I may say she got quite well. Also Lister wrote to John Bishop[1] and had the men and boys removed to a nursing home at his own expense. I think they all recovered. One of them was afterwards a doctor in Liverpool.

It is pleasant to remember that a great deal of this unseemly rigour disappeared in time. I think the 'Sister Superior' was removed. The *nurses* were kindly and sympathetic women as a rule."

This lack of sympathy and absence of enthusiasm amongst the sisters were unheard of in Lister's previous experience. He could hardly believe such a state of mind to be possible. It created an unpleasant atmosphere in the wards. But it did more. The success of his new treatment depended largely on the local assistance of the nursing staff in carrying out details which it was almost impossible for him personally to supervise. Their indifference or veiled opposition was therefore a source of real danger to his patients,—a new danger, which the nurses could not appreciate and which only existed where antiseptic surgery was being practised.

It was the almost invariable custom at that time for a member of the staff of each London Hospital to give an Introductory address to the students at the beginning of the winter session in October, which was also attended by his colleagues. Lister was asked to perform this duty at King's. It was his first public appearance in London and naturally attracted some notice. These addresses were commonly devoted to exhortation and precept, but sometimes the speaker employed the occasion for the discussion of a special subject of general and scientific interest. Lister decided on a special

[1] A very devoted house surgeon and for years Lister's private assistant in Edinburgh.

subject, and adopted the unusual course of illustrating the lecture with diagrams and specimens.

Stewart thus describes the preparation for it:

"Cheyne and I called at his house early in the afternoon. We found him in his shirt sleeves, perspiring as usual, busy getting in order the exhibits for his lecture. Mrs. Lister was helping, also his nephew . . . who had prepared some very beautiful coloured drawings as illustrations. . . . There was a large number of glasses and tubes, culture tubes we should call them, but that term had not then arrived, some containing milk which had been acted on by various kinds of germs, and some which had been kept successfully from infection. These stood on plate glass slabs and were covered by small glass shades. We drove from his house to the lecture hall in Somerset House. We supported the trays and glasses as carefully as possible. They had been brought successfully all the way from Edinburgh, but were now in perilous passages, there were occasional awkward jolts and they sometimes rattled terribly. I made some remark about 'Caesar and his fortunes' and I well remember his gentle, amused and somewhat pensive smile.

Lister was well received. The spacious lecture hall was crowded with an audience which contained not only many of the most distinguished physicians and surgeons of London, but some of the leading scientific men. For, although in his own 'household' of the healing art Lister was still subject to much disparaging criticism, he had now for many years been a distinguished member of the Royal Society, and of that inner circle of science in which the names of Darwin, Huxley, Tyndall, Hooker and Geikie shine."[1]

He chose for his subject "The Nature of Fermentation," the foundation stone of the antiseptic system, in the hope, as he said, that he might say something which should have interest and, if possible, even instruction, not only for the student, but also for the eminent men whom he had the honour to see around him. What he told them was not a mere réchauffé of previous work, but the result of experiments made after the end of the Edinburgh summer session and meditated over in the course of a three weeks' holiday in Italy in September.

He started with the fundamental question whether, in spite of well-established facts, it was conceivable that fermentation,

[1] "Symposium of Papers on the late Lord Lister." Read before the Academy of Medicine, Toronto, April 2, 1912. *Canadian Journal of Medicine and Surgery*, May 1912.

including putrefaction, was after all not caused by micro-organisms. After a short reference to the time-honoured practice of treading the grapes in wine vats, which he had just witnessed in North Italy, he showed them some of his liqueur glasses, covered with their loosely fitting glass caps, charged six weeks before, some with blood, and others with a mixture of blood and water which is far more putrescible. No contraction of the clot had taken place and the blood remained absolutely unchanged, though freely exposed to the action of the gases of the air; a proof that blood had no inherent tendency to putrefaction. But he told them that if he were to take a little morsel of already putrefied blood, say, upon the point of a needle, and touch with it this clot of blood, putrefaction would, in the course of a very short time, spread throughout the mass exactly as in the case of alcoholic fermentation under the influence of the yeast plant.

He then asked why, seeing that putrefaction never occurs without the presence of bacteria and bacteria always cause some fermentative process, it was still doubted whether the bacteria actually caused the putrefaction. He suggested that it was partly because bacteria are so small, and partly because many minds were confused by the mysterious action of chemical ferments such as emulsin and ptyalin, which produce fermentations limited in extent, but which have been proved beyond controversy not to be living agents.

The difficulty of proving that particular organisms caused particular fermentations depended on the difficulty of obtaining pure cultivations of the organisms. He proceeded to tell them how, by his recent researches, he had overcome this difficulty in the case of the lactic acid ferment to which he gave the name of Bacterium Lactis. Doubters had suggested that by boiling milk some chemical ferments, gratuitously supposed to exist in it, were destroyed. He therefore tried again and again, and for long unsuccessfully, to obtain a sample of milk fresh from the cow which, without boiling, underwent no fermentation of any kind. In spite of vigorous washing of the dairy woman's hands and the cow's teat, milk obtained in the cowhouse, small samples of which were placed in separate test tubes, always developed strange green

and red and many-coloured spots due to fungi and bacteria such as had probably never been seen before. But in no case did bacterium lactis appear, because this organism is rare except in connection with all the paraphernalia of a dairy. It swarms in dairies, and when it grows in milk takes precedence of all other organisms. No better success was obtained on a fine day in the open air close to the byre. But at last, working with very small quantities, and extra precautions, on a drizzling day, far off in the orchard, he succeeded in getting the contents of two minute test tubes to remain pure. This was the first step in the investigation. Milk it was clear had no inherent tendency to ferment, that is to turn sour.

The object of the second part of the investigation was to produce, if possible, absolute evidence that the bacterium lactis was the cause of lactic fermentation. By counting the bacteria in one field of the microscope of ascertained depth, he could estimate the number in say $\frac{1}{50}$th of a drop of any given sample of sour milk. By diluting this sample of milk with the requisite amount of boiled water, he calculated that each drop would contain one bacterium supposing that they were evenly distributed. Many glasses of boiled milk were inoculated with this highly diluted fluid. There was of course the risk that some other organism present in the soured milk might grow as well as the bacterium lactis, but as a matter of fact, he obtained a pure culture in one of the first four glasses experimented with, and from this strain he was able to produce at will the lactic acid fermentation, uncomplicated by any other change, in any sample of boiled milk. Thus the argument was definitely clinched.

This method, for long the only one of obtaining pure cultures, opened up the way for studying accurately the natural history of individual micro-organisms, which has developed so enormously and led to such far-reaching results.

No doubt it was unusual, and may to some have seemed inappropriate, for the professor of surgery to devote so large a portion of an introductory lecture to an abstruse subject like that of the lactic acid fermentation. But, rightly considered, it was most fitting that his first words in London

should explain the groundwork on which the antiseptic system was based. It was the first shot in the campaign, delivered at the earliest possible moment. For, as his concluding words showed, this single fermentative process was only used to illustrate the whole question of the nature of fermentation.

"What I do venture to urge upon you is, that you will seriously ponder over the facts which I have had the honour of bringing before you to-day; and, if you do so, I believe you will agree with me that we have absolute evidence that the *Bacterium lactis* is the cause of the lactic-acid fermentation. And thus I venture to believe that we have taken one sure step in the way of removing this important but most difficult question from the region of vague speculation and loose statement into the domain of precise and definite knowledge."[1]

The introductory lecture was, according to John Stewart,

"a brilliant and most hopeful beginning of what we regarded as a campaign in the enemy's country. But, whatever Lister's own thoughts may have been, the next few weeks were to us of his staff the abomination of desolation. There seemed to be a colossal apathy, an inconceivable indifference to the light which, to our minds, shone so brightly, a monstrous inertia to the force of new ideas.

We four unhappy men wandered about, now in the wards of King's, now through older and more famous hospitals, and wondered why men did not open their eyes. In these wards the air was heavy with the odour of suppuration, the shining eye and flushed cheek spoke eloquently of surgical fever. We would show them how things should be done! But how? We had no patients! We thought of the crowded hours of glorious work in Edinburgh, where Lister had half a dozen wards and sixty or seventy patients, and groaned over our two wards with capacity for a couple of dozen, but only empty beds. We remembered the enthusiasm about the introductory lecture of a session in Edinburgh, when the theatre would be crowded with four hundred eager listeners, and our hearts were chilled by the listless air of the twelve or twenty students who lounged in to lecture at King's."

The outlook certainly was dismal—a small number of beds and no patients, not even one for the first clinical lecture till a poor wretch with spinal disease and in an advanced state of consumption was discovered at the last moment. Perhaps it is unfair to criticize after so long a time, there may have

[1] *Collected Papers*, vol. i. p. 352.

been great difficulties, but it sounds as if the preparations made by the hospital authorities had been somewhat inadequate, and their reception of an honoured colleague scarcely hospitable. The beds were of course filled before long, but the difficulty of carrying out the Edinburgh system of clinical lectures and making ward visits as well, with so small a number of patients, was very great, and the inducement to persevere was diminished by the depressing indifference of the students.

What could be expected of London students, whose *esprit de corps* is not to be compared with that which abounds in the Scottish Universities? They have indeed some affectionate pride in their own hospitals, which, in the case of the smaller schools, does not amount to much, but they have none for their city or its university. Lacking this vital spark the majority become utilitarians, not searching after knowledge for its own sake, because the necessity of being in a position to earn a livelihood forces upon their attention the bugbear of the examination hall, where they will be tested by absolute strangers and miss the friendly encouragement of their teachers. Lister maintained, and it cannot be gainsaid, that the London system of examination encourages cram, stifles the spirit of enquiry and tends to reduce the teaching of medicine to one dead level—that of preparing students to answer the questions of a particular set of examiners. Thus the supposed views of the examiners rather than the real views of the teachers set the standard of instruction.

Unfortunately, just at the time Lister came to London this vicious system of education was becoming rampant. Coaching classes were the order of the day, about which he once made this pungent observation, "When I was a student it was an understood thing that only the most ignoble students went to what they called the 'grinder,' but now there are comparatively few who do not resort to the 'coach.'" He had an honest contempt for those "young men who devote themselves to the business of preparing specially for the examinations" and finding out what sort of questions are most likely to be asked. He held that

" students made a very great mistake in going to them rather than to those who are more experienced." [1] But the students preferred the short cuts to knowledge, and Lister's sphere of usefulness therefore was sadly curtailed. He had indeed to endure something of the cold douche his Edinburgh friends had warned him he must expect. It is remarkable that while every London teacher at the present day recognizes and deplores the defect in our teaching, those who, as Lister did, continue to point out the cause and to suggest the remedy are still, in many quarters, looked upon as heretics, or at best as fanatical advocates of the impossible.

Ten years later, during one of the many abortive attempts to organize a teaching University for London, Lister gave evidence before the Commission of 1889, of which Lord Selborne was the Chairman. His words are a confession of disillusionment, and a proof that contemporary accounts were not inaccurate. They also show that no improvement had taken place during the intervening years.

He had been describing his method of teaching in Scotland, and, in answering a question from the Chairman, said :

" A student could not tell how any particular material which I was bringing under his notice would bear upon the general subject ; he could not be the judge of these matters ; but when the whole course was completed (I do not like to speak egotistically, but I feel it almost my duty with regard to the important matter that we are considering) I have had the testimony of many men in after life that they derived great benefit from these instructions. I had there, I may say, an exceedingly regular attendance. I now know, I feel perfectly sure from subsequent experience, that if I had been teaching in the very same way and had had nothing to do with the examination of the students, my attendance would have been altogether different and my opportunities, therefore, of teaching would have been practically nullified. I am led to the conclusion by what I must speak of now as a humiliating experience of my own. I came from Edinburgh, by invitation of King's College, on the decease of Sir William Fergusson, and I undertook to teach clinical surgery on the same lines as I had taught it in Edinburgh ; but I found here that as the students did not find that the material I gave them seemed to be a direct preparation for the examination of the College of Surgeons they did not come to me ; and instead of a large class I have at King's

[1] Report of the Gresham Commission 1892, July 2, Q. 9565.

College a very small class ; I cannot calculate upon having the same men for two consecutive days. I have my own dressers and clerks, those who serve under me ; those are the only men I can reckon upon as regular attenders. You can see what an enormous difference this makes. If I had had no experience but this, I should have attributed it entirely to my own utter inadequacy as a teacher ; but having had my previous experience in two Scotch schools, I cannot but attribute it largely, if not exclusively, to the system. The tendency as regards the student while he is learning under the general teachers, if he feels that he is to be examined by somebody who is not his teacher, is to distract his attention from the teacher and to make him rather try to find out where he can get what are called 'tips' with regard to what is likely to be asked at the examination boards." [1]

Such then, so far as teaching was concerned, was the chilling and depressing situation. It is true that during the next few years there was an increase in the number of students, perhaps due in part to the influence of Lister's name; but they showed little enthusiasm about him, and there was never a large attendance at his lectures. Unfortunately, as he sadly owned, this did not diminish the trouble required in their preparation. The students soon found that if they aired his views, or advocated his practice at their examinations, it told against them and they were apt to be plucked ; so they rather avoided his clinic. Soon only a few, seldom more than a dozen, came to the lectures, mostly those who had passed in surgery and had no need to think any more about examiners. For years Sir Watson Cheyne says he attended regularly himself, so as to add one more to the class, because Lister used to feel the change from Edinburgh so acutely. The numbers were however swelled to some extent by the presence of a few general practitioners, and there was for several years a goodly attendance of foreigners.

This was really the only serious disappointment—bad enough it may be said—which Lister experienced in London. His relations with his colleagues, especially with the physicians and the younger surgeons, were cordial. Wood came to his wards and was so much struck with what he saw that he asked Lister to supervise the antiseptic arrangements for

[1] University of London Commission Report 1889, p. 44, A. 462.

two major operations: the removal of a large goitre which involved serious risk to life, and an ovariotomy. Ovariotomy in the general wards of the London hospitals was at that time a very dangerous operation; the results at King's had been so disastrous that the governors had forbidden the staff to undertake it. Both of Wood's patients recovered without any constitutional symptoms, and from that time, though he never said much, he was theoretically at least a convert. But though nominally convinced he never really thought that there was much in Lister's teaching; he said his fame came from Germany; that "the Germans were dirty people," and that "it was not really necessary in England."

Some others who only heard of what was taking place at King's College remained for a while sceptical and even scornful. Thus when in October 1877 Lister performed an "open operation" on a broken kneecap by wiring the two fragments together, a novel, and by some then thought to be an unjustifiable procedure, one of the best known London surgeons is reported to have said, "Now when this poor fellow dies, it is proper that some one should proceed against that man for malpraxis." But the expected catastrophe did not occur; healing pursued what is called "the usual aseptic course," a short phrase implying absence of local inflammation and of constitutional disturbance.

As equally severe operations, followed by equally happy results, were always to be found in his wards, it began to be recognized that something more than mere statistics of mortality after operations was required in order to test the value of the antiseptic system. These great cases were talked about and seen, and there can be no doubt that the fact that they were in evidence did more than any of his writings, or the statements of others about the revolutionizing of surgical practice in Scotland and Germany, to convince London surgeons of the truth and the value of Lister's teaching. So that in this most important respect his coming to London effected its object.

Those London surgeons who had uttered hard sayings about Lister and all his works when he was at a distance, found it impossible to quarrel with him at close quarters.

Far from being the conceited and overbearing boaster they had pictured to themselves, he proved to be a humble-minded and courteous gentleman who treated them with respect and commanded the same in return. But the words he had used in the spring about the system of teaching clinical surgery in London still rankled, and as he now heard more in detail about the manner in which this instruction was actually conducted, and found that his information regarding it had not been quite up to date, he took an early opportunity of making the *amende honorable*. In a clinical lecture which was afterwards published, he said:

"I may take this opportunity of expressing my sincere regret that certain expressions which I employed before I left Edinburgh should have seemed capable of interpretation as casting the remotest possible slur on the surgeons of this Metropolis. Nothing certainly was further from my intention. I did, indeed, while speaking under circumstances peculiarly difficult and embarrassing, allow an expression to escape my lips which I should not have uttered under any circumstances had I supposed that my remarks were likely to be published; and I am truly sorry for the needless offence which I have thus given. For the leading surgeons of London no one, I venture to say, entertains higher respect than myself. I referred not to the London teachers, but to the system on which clinical surgical lectures were given in London; which, so far as my knowledge extended, seemed to me essentially inferior to that in use in Edinburgh; partly because they were not demonstrative, and partly because, being given at rarer intervals and in conjunction with one or more colleagues, they could not, from the nature of things, approach to the characters of a complete course.

Not that I wish to underrate such clinical lectures in London as I refer to. In proportion to the ability and experience of the lecturer such discourses have their high value. But referring, as they do, to cases which are not present before the student, and which many of the audience may perhaps never have seen at all, they might often, except for the effects of voice and manner, be as well read as attended. Such lectures are in reality far more ambitious and involve greater talent and literary effort than ours, which are comparatively humble performances, standing much in the same relation to a course of systematic surgery as anatomical demonstrations to lectures on anatomy. But, simple as they are, they fill a place in the medical curriculum which, I believe, is second in importance to no other, and which cannot be filled adequately either by clinical lectures otherwise conducted, or by bedside teaching or tutorial instruction.

My own conviction of the importance of the subject is, at least, sufficiently shown by the fact that upon the question whether or not arrangements could be made to enable me to conduct my course here exactly in the same manner that, following the example of Mr. Syme, I had found so advantageous in Edinburgh, depended my acceptance or otherwise of the highly honourable offer of a clinical chair in King's College." [1]

So much he said in the lecture. In publishing it this postscript was added:

" In publishing this lecture I wish to add two remarks in order to avoid misunderstanding. First, that I do not omit bedside instruction, and always warn my class that no lectures can possibly take the place of their own individual work at the bedside, since it is essential, in order that the student may become a competent practitioner, that he should handle diseases as well as see them, and not only witness their treatment by others, but be personally concerned in their management by holding dresserships, etc., in our hospitals. Secondly, I desire to add that, since I used the expressions in Edinburgh above referred to, I have been informed that clinical surgical teaching in London has undergone considerable changes since I was a student, both as regards giving it a more demonstrative character, and in greater frequency and regularity of meetings of the classes. The London schools are both numerous and independent, and the changes to which I allude have, I understand, taken place in different degrees in different institutions. Hence, I can quite understand that my general remarks, made, as I would repeat again, without any view to publication, may have done individual injustice, for which no one could be more sorry than myself."

Thus ended this regrettable incident. There had been misunderstandings on both sides. As far as Lister was concerned, he had now made his position perfectly clear.

A week after the delivery of this lecture came the address to the Pathological Society, originally promised for the spring, but postponed because of the negotiations with King's College. The meetings were held at the house of the Royal Medical and Chirurgical Society in Berners Street. The Pathological Society was then in the full vigour of its prime; the meetings

[1] " Clinical Lecture on a Case of Excision of the Knee-joint, and Horsehair as a Drain for Wounds, with Remarks on the Teaching of Clinical Surgery," *Lancet*, 1878, vol. i p. 5; *Collected Papers*, vol. ii. p. 451.

were always well attended and the debates generally lively. Lister's first appearance before a London medical society excited much interest, and the old library was packed full. He was elected a member in the course of the evening and then gave what the *Lancet* called "a remarkably lucid and well-reasoned address," containing a complete history of his researches on the nature of the lactic fermentation, and many deductions therefrom as to the bearings of this process on pathology.[1]

It was delivered extempore and was listened to with close attention. He began by saying that a few years ago it would have seemed very improbable that the souring of milk should have any bearing upon pathology. But the large and influential audiences which had recently been gathering to listen to Dr. Burdon Sanderson's "Brown" lectures on the infective processes of disease, at the University of London, showed that the essential nature of fermentative changes was occupying a prominent place in the minds of pathologists. Medical men were, he thought, apt to begin their study of such infective diseases as pyaemia at the wrong end; that is, to view them from the clinical rather than from the pathological aspect. But before any sure step could be taken with regard to fermentative, or, in other words, infective diseases in the human subject, it was necessary to have clear ideas, distinct opinions, and positive knowledge, on such fermentative processes as could be studied in the laboratory, and which, on that account, were more simple subjects for investigation. This was his excuse for bringing before pathologists the result of investigations into the history of one particular ferment.

The structure of the address was on the lines of his introductory lecture at King's College. It was a demonstration: first, that unboiled milk has no inherent tendency to ferment, and secondly that the particular organism which he had

[1] *Collected Papers*, vol. i. p. 353, "On the Lactic Fermentation, and its Bearings on Pathology."

Trans. Path. Soc. Lond. 1878, vol. xxix. p. 425. The plates are very much better than in the *Collected Papers*.

Lancet, 1877, vol. ii. p. 918. The account in the *Lancet*, though much abridged, contains some matter absent from the published report.

isolated and grown in pure culture was the common—though perhaps not the only—cause of the lactic acid fermentation.

Many parts of this address have been already referred to. They may therefore be passed over here in order to draw special attention to other important matters which were dealt with in the course of it.

1. The precise method of his manipulations, much simplified since the time of his earlier bacteriological publications, was not only described but demonstrated. For the first time a public exhibition was given of the way in which a pure cultivation of any organism could be obtained almost with certainty. He explained the structure of the improved "hot-box" he was using at the time, the plan he had devised for maintaining a uniform temperature and the precautions taken for filtering the air that entered the box during the process of cooling, which, at that time, were thought to be essential. He brought down his liqueur-glasses and test-tubes with their loosely-fitting caps, described in a previous chapter.[1] He also showed the special flask which he employed for introducing pure organic fluids into previously superheated glasses without fear of contamination, and the apparatus by means of which he had successfully overcome the tendency to frothing when milk is raised to the boiling point. After adopting this simple plan he said he had charged many flasks with milk and never failed. "Here is a flask of boiled milk (or rather of milk that has been exposed to a temperature of 210°) prepared on the 7th of August [nearly five months before], and remaining we may safely say as pure as it was then. You observe it is still perfectly liquid and unaltered in appearance. Now I venture to remark that this failure and correction of the failure are extremely instructive, as showing how the development of organisms under circumstances in which we cannot at first explain their occurrence may be really due to fault on our part, defect in our own manipulation."

The audience could thus see for themselves with what simple apparatus he worked, and the inventive genius by which he overcame, one after the other, the minor defects that inter-

[1] See page 266.

fered with its efficiency. This part of the address may seem to the modern reader rather long, but at the time it had all the attraction of novelty and even now has much more than a mere historic interest.

2. His plan of diluting soured milk with so large a quantity of water that each drop of the mixture would contain only one bacterium if they were evenly distributed, settled a difficulty raised by the disbelievers in the germ-theory of fermentation. It proved beyond doubt that the cause of the fermentation is not in solution as had been suggested, but consists of insoluble particles; for it turned out that the bacteria were not evenly distributed, and that if single drops of the diluted sour milk were added to a number of vessels containing pure boiled milk, the lactic acid fermentation did not take place in all of them; whereas if the ferment had "been dissolved in the water of inoculation, every equal sized inoculating drop would have produced the same fermentative effect." "It is true," he said "that this proof applies only to one particular kind of fermentative change. But the same method will, I believe, be found applicable in other instances for the purpose of ascertaining how far the rule is universal that a true fermentation, by which I mean one characterized by the faculty of self multiplication of the ferment, is caused by the development of an organism. In the meantime, as a contribution of a definite character, so far as it goes, to the elucidation of the nature of fermentative changes, so fraught with interest at the present day alike to the physician and the surgeon, I trust it will not be considered unwelcome to the Pathological Society."

3. The acid smell of sour milk led to an abstruse chemical discussion of great importance, very difficult to explain in a few words. Sour milk smells sour, but lactic acid is not volatile and has no smell. In order to see what this volatile odoriferous material was, Lister distilled some milk which had been soured by means of a pure cultivation of bacterium lactis. The first distillate had a pungently acid smell, but not an acid reaction. It was some ethereal substance, obviously not lactic acid, but its precise nature had not then been ascertained. This experiment proved that during the

action of bacterium lactis on milk other substances are formed besides lactic acid, just as succinic acid and glycerine are produced in the course of the alcoholic fermentation. It suggested the possibility of these by-products being the agents, which, by a catalytic action, like that of the chemical ferments, caused the conversion of sugar of milk into lactic acid. This was almost, if not quite, the suggestion thrown out by Liebig. Lister said: "Thus, so far as I am aware, it is, in the present state of our knowledge, an open question whether in the case of the lactic fermentation, as it occurs in milk, the *Bacterium lactis* may not derive its nourishment exclusively from the caseine, the decomposition of which may act catalytically upon the milk-sugar. In that case the old view of the caseine being the ferment would have so much of truth in it that, though not the primary fermenting agent, it would occupy the position of an intermediary between the organism and the material which undergoes fermentation."

4. This was the occasion on which he recanted and offered an explanation for the mistake he had made four years previously[1] in concluding that bacterium lactis was developed from a filamentous fungus. His work now rested on a firm basis, and he was able to show that, by growing the organism in the different media he employed, only alterations in size but none in form were produced.

5. The variations in size of bacterium lactis under different conditions, and a comparison of this minute organism with the large yeast plant, supplied him with an argument in favour of the existence of organisms so small as to be ultra-microscopic. This was his last theme. He urged that it would be wrong to say that such diseases as erysipelas, which behave like septic diseases, are not caused by organisms because none had ever been seen. The organisms might well be so small as to be invisible by the highest magnifying powers we shall ever be able to manufacture. And, if this be the case, it is needless to suppose that they all have spores or as he called them germs. In one or two bacteria, supposed spores or germs had undoubtedly been seen, but he thought

[1] See page 274.

it probable *a priori* that bacteria did not require germs. We see them reproducing themselves. " They constitute, in fact, in the adult form, a reproductive apparatus; perpetually multiplying with amazing rapidity by fissiparous generation." " Meanwhile," he said in conclusion, " the facts which I have adduced will, I hope, remove the mystery attendant on the notion that water teems with ultra-microscopic or invisible germs of the bacteria which we see of larger or smaller dimensions in organic liquids undergoing fermentative changes."

Murchison's promise of a brilliant reception had been fully realized. In congratulating Lister he made some graceful allusions to his experimental skill and scientific learning. Dr. Bastian, even then a recognized champion of spontaneous generation, who for nearly forty years afterwards continued to pursue his researches on the subject, admitted that Lister's experiments seemed to be convincing as to the truth of the conclusions which he drew from them, and that it was difficult to find any flaw in them or in his reasoning. But he asked whether, under other conditions, the same conclusions would still be possible. Into these other conditions we cannot now enter, they are the basis of the stock arguments of those who believe in spontaneous generation. That was not the subject under discussion, there is therefore no need to say how their observations are criticized and their arguments met. Bastian seconded the vote of thanks proposed by Burdon Sanderson, who also fully concurred in Lister's conclusions and in what he said on the subject of germs.

CHAPTER XXVI

CONGRESSES AND ADDRESSES
(1878-1881)

LISTER's presence in London was a godsend to the secretaries of medical societies anxious to provide attractive programmes for special or annual meetings. Requests for addresses were numerous, and could not always be refused. One of these addresses given to the Harveian Society[1] in May 1878 has been partly dealt with in a previous chapter,[2] but contains other matter of exceptional interest.

The name of Harvey suggested to him some hitherto unpublished observations, begun fifteen years before, on the effects of the position of a part of the body upon the circulation of the blood through it.

General practitioners are strongly represented in the Harveian Society. Its discussions are therefore mostly of a practical nature. The address had no doubt many practical bearings and suggestions, but, dealing as it did with a complicated question of physics, rendered more complicated still by being associated with problems of muscular contraction and nervous energy, it must have surprised and perhaps puzzled some of the habitual attenders of the meetings.

The subject was constantly in Lister's mind. He was fond of showing how pain may be relieved and healing promoted by modifying the position of an affected part; of explaining the rationale of a fainting fit; and of pointing out that the familiar cure for nose-bleeding by holding up

[1] *Brit. Med. Journ.* 1879, vol. i. p. 923; *Collected Papers*, vol. i. p. 176.

[2] See page 100.

the hands is not merely an old wives' fable, but a rational and often a successful treatment. But above all he was in the habit of using these homely facts as illustrations of the importance to the practical doctor of a sound knowledge of at least the fundamental laws of physics, and he never ceased to bewail the tendency of examining boards to require nothing but a useless minimum, or even to exclude this subject altogether from the curriculum.

It may have been difficult to follow all the details concerning the pressure of fluids in elastic tubes moving under intermittent pressure, as the blood does in the arteries under the intermittent *vis a tergo* of the heart; and the difficulty must have been increased when he pointed out that the arteries are not merely elastic tubes, but subject to contraction and dilatation under the influence of the nervous system. But the illustrations brought forward were of the simplest kind—such as all could see and easily understand. They are indeed good examples of Lister's habit of enforcing an argument by appealing to common every-day facts,—so ordinary perhaps, and so constantly seen, as to be thought unworthy of notice.

It will be remembered that he was the first to devise a method of bloodless operating, having anticipated Esmarch by several years.[1] His plan was to raise the limb into a vertical position. In a few minutes it became bloodless and assumed a deathlike pallor. A tight band, completely controlling the circulation, was then passed round the limb at some point nearer the heart than the seat of operation. The operator was thus not confused by the presence of blood in the wound, and the most minute dissection could be made with the same accuracy as on the dead body. This emptying of the limb he had shown to be not a simple mechanical process, but the result of the contraction of the arteries under the influence of the nervous system.

The point to which he now directed attention was the striking fact that when the constricting band was relaxed, the limb quickly became engorged with blood and suffused with a scarlet blush which lasted a considerable time. The

[1] See page 99.

demonstration of this phenomenon, which was intended to lead up to its explanation, shall be given in his own words.

"I will now ask this man (with his arms bare) to raise one hand high into the air, while the other hangs beside him. You observe at once the striking contrast between the two. In the one elevated, not only have the veins entirely collapsed, but the colour is almost that of the limb of a corpse. So white is the hand as to imply that the minute arteries must surely be in the same state of extreme constriction as occurs during syncope.

I will now apply to the arm close to the axilla a bandage of elastic webbing, putting on the first few turns with firmness and rapidity, so as to avoid any intermediate condition of engorgement through obstruction of the return by the veins before the arteries are completely compressed; while the later turns may be put on, if we please, more leisurely and with less firmness, to ensure, by the accumulation of the elastic force, complete maintenance of such constriction of the limb as prevents all circulation. The elastic band having been fixed with a pin, the limb is lowered and the man will stand aside for a few minutes."

For eight minutes he discoursed on difficult physical problems, and then continued:

"That the force of the heart is amply adequate in the human subject to drive the blood freely through the vessels of the distal parts of a limb, in spite of the elevated position, provided that the arteries are relaxed, I shall now have the means of plainly demonstrating. The constricting band has been on this man's arm for eight minutes, yet, thanks to its efficacy as a tourniquet, the limb remains as pale and corpse-like as when the application was made, although he has kept his hand down in the interval. I shall now ask him to raise the hand again to the utmost degree; and, while it is so placed, I shall remove the elastic bandage. This having been done you observe that the skin of the hand is beginning to show patches of redness, and now, a few seconds more having elapsed, even the finger-tips, as well as the rest of the limb, are of florid red hue. The veins, you see, remain collapsed, the blood being continually drained out of them by the action of gravity; but the arteries, in spite of that action, instead of being empty or nearly so, as they were when the limb was previously elevated, are distended even to the remotest capillaries. He will now raise the other hand, and you observe the extraordinary contrast between the two limbs, both in the elevated position, the hand last raised becoming as pallid as the other did before the elastic band was applied."

The brilliancy of the blush and the length of time it persisted depended on the length of time the bloodless condition of the limb had been maintained. He therefore said:

"That which seems to me to be probably the true explanation is, that when a part has been deprived for a while of circulation, the want of the vital fluid creates in the tissues a demand for a supply of it, and that this demand operates upon the vaso-motor nervous apparatus of the limb as a stimulus inducing arterial relaxation, in a manner perhaps analogous to that in which the 'besoin de respirer,' as the French have termed it, produces a stimulus to the respiratory nervous system."

If this reasoning were correct the more vigorous the circulation the greater would be the arterial relaxation, and the contrast between the pale and the blushing hands. It was quickly put to the test. Lister sometimes boasted that he could cast all cares away and devote himself unabstractedly to the business or recreation of the hour. But no time was inopportune for an observation or experiment, not even the anxious moment of hurrying to a train.

"My first trial of this kind," he said, "was made just after I had been walking with great haste to catch a train, when my heart was beating with unusual vigour, and my hands were of a florid colour. Having raised my left hand, I saw it become, within half a minute, very pale, and on putting it down after it had been a minute in that position, I observed it grow, within a quarter of a minute, much deeper in arterially red tint than the right, a difference which gradually passed off, so that, in the course of one minute and three-quarters, the hands were again of equal colour. Two minutes later, I repeated the experiment, and this time kept the left hand raised for two minutes, and then, on lowering it, found it to become in ten seconds much redder than the other, which had been suspended the whole time; and, just as might have been expected after the more protracted action of the nervous apparatus, the repose was longer in duration, so that, even after two minutes and twenty seconds, when I was obliged to start for the train, the left hand was still slightly the redder of the two."

The station officials must have wondered at Lister's strange signalling; lay readers may gather a characteristic picture of him; and physiologists will agree with the concluding words of the address: "Hence this apparently trivial experiment, if duly considered, seems to me of itself sufficient

to prove the truth of the doctrine for which I am contending."

On June 5th, 1878, soon after the delivery of this address, Lister was gazetted Juror of the Class 14 (Medicine, Hygiene and Public Relief) at the great Universal Exhibition at Paris. The appointments were made by the Prince of Wales as President of the British Commission. The pleasant visit arising out of this quite unexpected appointment is thus described in a letter to his brother, 13 June 1878:

"We are having a very interesting time here. I have long wished to visit Paris again, so as to see something more of its medical Institutions than I had done; and the present occasion puts this in my power by enforcing a stay in the gay city. I have visited two of the hospitals, with much interest, and was very kindly received; the contrast with the position I was in when I stayed last in Paris, in 1855, being very striking to me. Then I was of course an unknown stranger: now I am treated as a celebrity. The Academy of Medicine have requested me to give them some communication, and I have agreed to repeat to them what I gave to the Harveian Society on the effects of position upon the local circulation. I have not nearly finished writing it in English; and therefore to get it ready for delivery in French by next Tuesday will be rather a serious undertaking! As a rule a certain time only is allotted for every communication; but I am to have the whole sitting at my disposal. The meeting is in the afternoon, and at 7 p.m. on the same day Agnes and I are to dine with Dr. Gueneau de Mussy, who was physician to Louis Philippe and stayed with him in England during his exile. He thus knows English well, and he is also an intimate friend of Pasteur who will meet us at his house. He told me my Introductory at King's, which he saw in the *British Medical Journal*, had made his heart beat and that he went off at once with it to Pasteur."

Lister was chosen President of the Jury on matters connected with the medical profession, which kept him fully occupied, but allowed time for some serious scientific talk with Pasteur and a further cementing of their friendship.

The Sixth International Medical Congress met in 1879, in Amsterdam, and was no less interesting than its predecessors. Lister, who was impelled by a sense of duty as well as by inclination to attend these important medical

assemblies, was amongst the most honoured guests. A graphic account of the great reception accorded to him appeared in the *British Medical Journal.*

"The public meeting of Tuesday was principally devoted to an address by Prof. Lister, in reply to various objections that have been made to the antiseptic system. Professor Lister was received by the whole Congress with an enthusiasm which knew no bounds. When he stepped forward to the desk to open his address (which was delivered, with but few notes, in improvised French), the whole assembly rose to their feet; and, with deafening and repeated rounds of cheers, waving of hats and handkerchiefs, hailed the distinguished Professor of King's College with acclamations renewed minute after minute, and time after time, as his name was again shouted forth by some grateful and enthusiastic acolyte. This remarkable scene—unprecedented, we imagine, in the history of medical science—continued for some minutes, until Professor Donders, the President, advancing with the distinctive grace and dignity for which he is remarkable, and taking Professor Lister by the hand, as he stood overwhelmed with this magnificent ovation, obtained a moment's silence, and addressing him said: 'Professor Lister, it is not only our admiration which we offer you; it is our gratitude, and that of the nations to which we belong.'" [1]

Medical congresses are not devoted entirely to dull science. The doctors are out for a holiday, and the jovial Dutch burghers vied with one another in graceful hospitality. At any time the beautiful city of Amsterdam *en fête* is a sight not easily forgotten. On this occasion there was a musical festival in the park, with fireworks and set pieces of Hippocrates and Hygeia. On another evening there were tableaux vivants arranged by a well-known artist. One of these was from the print of Ambroise Paré dressing a wounded soldier, but, in the place of Paré, Lister appeared, and in the foreground an immense foyer of carbolic acid.

"The idea was immediately seized, and from the whole theatre there arose such an universal acclamation, with continuous ovation to the name of Lister, that it was only after Mr. Lister had, under compulsion, bowed his acknowledgments from his place, and after the curtain had risen and fallen three times, that the enthusiasm subsided."

[1] *Brit. Med. Journ.* 1879, vol. ii. p. 453.

On the last evening there was a great banquet, after which a fanfare of trumpets was heard without, and the guests adjourned to the balcony. The students had assembled with bands and torches lighting up the narrow way bordering the canal; Donders made a graceful speech, and then there were renewed cries for Lister, who was again the subject of an enthusiastic and picturesque ovation. It was a scene worthy of the home of Rembrandt, and it closed with an eloquent speech from Virchow, "which flowed on until it grew into an address of such brilliant, noble and earnest words as few men can command even in their happiest moments of inspiration."

An address which Lister delivered before the Pathological Section of the British Medical Association at Cambridge in August 1880, is exceptional in containing no original work of his own. It is an important summary and criticism of the then recent additions to knowledge with regard to the relations of micro-organisms to disease.[1]

We now hear for the first time of Robert Koch, who became, as is well known, one of the most distinguished bacteriologists of his day. Lister said:

"First, I will mention some examples of the labours of Dr. Koch, of Wollstein, in Germany. Though a hard-worked general practitioner, Koch has contrived to devote an immense amount of time and energy to his investigations; and by a combination of well-planned experiments, ingenious methods of staining bacteria out of proportion to the tissues among which they lie, a beautiful adaptation of optical principles to render the coloured objects discernible by the human eye, and, further, by a most successful application of microphotography, he has succeeded in demonstrating the presence of these minute organisms in a manner never before attained."

No mention is made of Koch's use of solid instead of fluid media for the cultivation of micro-organisms;[2] probably he had not yet published it; but he had succeeded in making use of the living mouse for isolating in pure culture an organism

[1] "On the Relation of Micro-organisms to Disease," *Quart. Journ. Micros. Sci.* 1881, n.s. vol. xxi. p. 330; *Collected Papers*, vol. i. p. 387.

[2] See page 444.

which is the cause of a form of septicaemia to which this animal is particularly liable. Commenting on this Lister said:

"Thus the animal body, which had previously been an obscure field of labour in this department, in which the pathologist did little more than grope in the dark, was converted by Koch into a pure cultivating apparatus, in which the growth and effects of the micro-organisms of various infective diseases could be studied with the utmost simplicity and precision."

The only completed work of Koch's to which reference is made is that on anthrax, spreading gangrene, septicaemia of mice, and a special variety of erysipelas; but he was on the eve of announcing still more important discoveries.

Lister then turned to Pasteur's investigations into a disease, which, he said,

"has been somewhat inappropriately termed *Choléra des poules*, or fowl-cholera, for it is not attended with diarrhoea or any other of the symptoms of cholera; but, as it happened to be extremely destructive among the poultry yards of Paris at the same time that an epidemic of cholera was raging in the city, the disorder which prevailed among the fowls was also given the name of cholera."

The study of this affection led to what was perhaps the most important of Pasteur's discoveries,—the means of protection against disease by vaccination with attenuated viruses, which Lister thus shortly describes:

"By cultivating this bacterium in a particular manner, which he has not yet published, he enfeebles the organism, as he believes, and produces such an alteration in it that, when inoculated into a healthy fowl, it produces only a modified, and no longer fatal form of the complaint; but the bird is thereby rendered secure against taking the ordinary form of the disease. It has been really vaccinated, if we adopt M. Pasteur's extension of the term vaccination to other similar cases; for just as we speak of an iron milestone, we may, if we please, apply the term vaccination to the use of a virus other than the vaccine obtained from a heifer."

This was the beginning of the scientific study of vaccines, antitoxins and serums, which since that day has assumed such vast proportions that some even speak of bacteriology as not merely the handmaid of medicine and surgery, but as destined to supplant them almost completely.

Pasteur seems to be referring to this subject in a letter to Lister written in the early part of this year.

" PARIS le 2 Janvier 1880.

CHER ET TRÈS ÉMINENT CONFRÈRE,

Je vous suis fort obligé de votre lettre, et des vœux de bonheur que vous voulez bien former pour ma famille et pour moi. Notre nouveau jeune ménage est très heureux et c'est, pour ma femme particulièrement, une grande joie d'avoir auprès d'elle, dans la même ville, sa chère enfant. Ce soir nous leur lirons en famille l'expression de votre gracieux souvenir.

J'ai été heureux et fier de votre grand succès au congrès médical d'Amsterdam, dont l'exposé de vos pratiques chirurgicales, de plus en plus triomphantes, ont été le principal ornement.

Quant à moi, je suis toujours occupé de l'étude des contages vivants et de l'étiologie des maladies qu'ils déterminent. Les connaissances médicales et chirurgicales me font défaut ; mais j'espère néanmoins que mes recherches seront utiles si j'ai la sagesse de rester sur le terrain restreint que je m'impose. Ce que je désire surtout, c'est d'apporter des preuves indiscutables de la part considérable que les organismes microscopiques exercent dans certaines et probablement dans toutes les maladies transmissibles. Et n'est-ce pas dans ces maladies qu'apparaît vraiment la grande pathologie ! La médecine et la chirurgie même seront bien avancées le jour où on connaîtra la nature et les propriétés de tous les contages vivants. L'homme est sans puissance contre un ennemi inconnu et invisible. Sa situation alors me rappelle hélas ! celle de nos pauvres soldats dans la guerre de 1870, lorsqu'ils recevaient dans leurs rangs pressés des obus prussiens partout de points placés hors de la portée de la vue.

J'espère publier avant la fin de l'année qui commence des études qui vous intéresseront. Je m'empresserai de vous en faire part.

Veuillez agréer, cher et très éminent confrère, avec mes remerciements, la nouvelle expression de mes sentiments de très cordiale amitié.

L. PASTEUR."[1]

In view of the approaching Cambridge address Lister wrote again to Pasteur, who thereupon sent him two vaccinated

[1] " PARIS, Jan. 2nd, 1880.

DEAR AND VERY DISTINGUISHED CONFRÈRE,

I am much obliged for your letter and your good wishes for my family and myself. Our new young household is very happy, and it is a great pleasure especially for my wife to have her dear daughter close to her in the same town. This evening at our family gathering we will give them your kind message.

I have been happy and proud over your great success at the Medical

fowls, one of which he showed at the meeting and thus described:

"Through the great kindness of M. Pasteur, I have now the opportunity of showing to the Section a hen which has been treated in this way. You observe a slough on the breast of the bird about as large as a penny piece; it is dry, and obviously old. The fowl has been some days in my possession subsequently to its journey from Paris; but though more than enough time has elapsed since the inoculation to have caused its death, had the disease been in the ordinary form, it is, you see, in good health, bright and active, and it both eats and sleeps well."

The following letter from Pasteur, interesting from its reference to germs of bacteria, and doubly interesting from its expression of his views with regard to the publication of incomplete investigations, accompanied the fowl.

"ARBOIS (Jura) le 7, Août. 1880.

CHER ET ILLUSTRE AMI,

Je reçois votre lettre à Arbois (Jura), où je suis venu prendre quelque temps de repos. Sans retard j'y réponds en vous informant qu'heureusement un de mes aides est encore à Paris et que je viens de lui télégraphier de mettre tout de suite en culture la microbe du choléra des poules et de vous en expédier un tube à l'état de pureté. Je pense qu'il saura s'acquitter très bien de cette mission.

Congress at Amsterdam, the most striking feature of which was the demonstration of the ever increasing triumphs of your surgical methods.

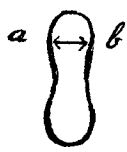
As for myself, I am always working at the study of living contagia and the etiology of the diseases they produce. I have no medical or surgical knowledge, but in spite of this I hope that my researches will be of some use, if only I have wisdom enough to be content with the restricted field which I have prescribed for myself. My chief desire is to produce indisputable proof that microscopic organisms play a considerable part in some, and probably in all infectious diseases. And is it not in connection with these diseases that the essential greatness of pathology is clearly demonstrated? Medicine and even surgery will make a great step forward as soon as we become acquainted with the nature and properties of all living contagia. Man is powerless against an unknown and invisible enemy. His situation in such circumstances reminds me alas! of that of our poor soldiers in the war of 1870, when everywhere Prussian shells kept falling into their harassed ranks from points beyond their range of vision.

I am hoping to publish before the end of the year that is now beginning, some investigations which will be of interest to you. I will lose no time in telling you about them.

With renewed thanks, dear and very eminent confrère, and very cordial expressions of friendship,

L. PASTEUR."

La forme du petit organisme est celle du *mycoderma acéti*, et de tant d'autres de ces petits êtres, mais semblablement plus petit que le *mycoderma*. Après quelques jours la culture s'éclaircit, la dépôt diminue de volume et on ne trouve plus à sa place qu'un amas de points d'une ténuité extrême, d'un diamètre environ 3 fois moindre que le diamètre en largeur des petits articles étranglés primitifs. C'est tout à fait exceptionellement que ces petits articles se mettent en chaînes et persistent dans cet état. Les points, si petits qu'il faut savoir qu'ils existent pour les bien voir au microscope, sont-ils les germes de l'organisme ? Je le crois. Mais nous sommes loin encore de tout comprendre dans la morphologie et les états successifs de ces petits productions.



ab est d'environ 1/2 à 1 millième de millimètre.

Je serais très heureux de pouvoir vous dire tout ce que je sais sur l'atténuation des virus très infectieux ; mais vraiment je ne le puis pas, non par le vain désir de cacher un secret et de conserver une observation qui me met en avant des autres, mais par prudence scientifique et parceque je ne suis pas satisfait de mes connaissances. Elles sont trop incomplètes ; elles sont trop mêlées de circonstances que je ne puis comprendre. Je tiendrais à avoir d'autres virus attenués. Par ceux-ci, je le crois, la lumière se ferait sur les obscurités qui m'enchaînent encore dans un silence plus gênant pour moi que pour le public.

Si vous en avez le temps inoculez quelques poules.

Je vous fais adresser également deux poules vaccinées, avec séquestres sous la peau que vous pourrez extraire. Cela vous intéressera vivement au point de vue chirurgical.

Veuillez agréer la nouvelle assurance de mes sentiments de très haute estime et de sincère amitié.

L. PASTEUR.

L'immunité a duré plusieurs mois.

J'ai près de 200 poules vaccinées qui attendent des épreuves ultérieures. À mon retour à Paris j'en inoculerai de nouveau une première série." [1]

The next reference in the Cambridge address was to some experiments of Burdon Sanderson and Dr. Greenfield, who

[1] "ARBOIS, JURA, Augst. 7th, 1880.

DEAR AND ILLUSTRIOUS FRIEND,

I have received your letter at Arbois (Jura) where I have come for a little rest. I answer it at once to tell you that fortunately one of my assistants is still in Paris, and that I have just telegraphed to him to

had succeeded to the Brown Professorship at the University of London. The former had shown that the bacillus of anthrax lost its virulency for herbivorous animals by growing in some rodent animals such as guinea-pigs. Thus a calf inoculated from a guinea-pig dying from anthrax, suffered from a very mild attack of the disease. Greenfield, who now entered the ranks of investigators of this complicated subject and worked at it with great energy and success, proved that this mild attack conferred immunity.

Meanwhile, Toussaint of Toulouse, who was present at the meeting, a friend of Lister's and the discoverer of the organism of choléra des poules, was trying to find out whether the immunity conferred by vaccination might not be caused by the mere chemical products of the organisms quite independently of their actual bodily presence alive or dead.

start a culture of the organism of chicken cholera at once and to send you a tube of it in a pure condition. I think he will be able to carry this out very satisfactorily.

The little organism has the same shape as that of the *mycoderma aceti* and so many others of these minute beings, but it is apparently smaller than the *mycoderma*. After a few days the culture becomes transparent, the deposit diminishes in volume, and in place of it there is only found a mass of extremely small points with a diameter a third less than the transverse diameter of the original minute constricted forms. It is altogether exceptional for these little forms to be arranged in chains and to continue in this condition. Is it possible that these points, which are so small that they could not be seen with the microscope if one did not know that they were there, can be the spores of the organism ? I think so. But we are still far from knowing all about the morphology and the intermediate forms of these minute bodies.

I should be very pleased if I could tell you all I know about the attenuation of very infectious viruses ; but indeed I cannot do so, not from the vain desire to hide a secret, and hold back an observation which gives me an advantage over others, but from scientific caution and because I am not satisfied with the state of my knowledge. It is too incomplete and too much confused by things I do not yet understand. I am hoping to have other attenuated viruses. I think that by means of them some light will be thrown upon the darkness which still compels me to preserve a silence more trying to me than to the public.

If you have time for it inoculate a few fowls.

I will have two vaccinated fowls sent to you with sequestra under the skin which you can remove. That will interest you keenly from the surgical point of view.

With kindest regards and sincere friendship,

L. PASTEUR.

The immunity has lasted for several months.

I have nearly 200 vaccinated fowls which are waiting for further experiments. On my return to Paris I will again inoculate a first series of them."

He worked with anthrax, either destroying the organism in his vaccine by heat, or removing it by filtration. He reached the conclusion, which, however, he subsequently saw reason to doubt, that the presence of the living organisms was not essential. On this Lister observed:

"I need hardly remark on the surpassing importance of researches such as these. No one can say but that, if the British Medical Association should meet at Cambridge again ten years hence, some one may be able to record the discovery of the appropriate vaccine for measles, scarlet fever, and other acute specific diseases of the human subject. But even should nothing more be effected than what seems to be already on the point of attainment—the means of securing poultry from death by fowl-cholera, and cattle from the terribly destructive splenic fever—it must be admitted that we have here an instance of a most valuable result from the much-reviled vivisection."

Finally he told them of a series of laborious experiments by Buchner of Munich showing that the non-virulent hay-bacillus can be cultivated up into the virulent bacillus of anthrax and that conversely the bacillus of anthrax can be domesticated, as it were, into the hay-bacillus. Buchner's results had not at that time been confirmed. Virchow spoke of him and his work in the following year in terms of high praise. Subsequent discoveries of the same nature, which even at the time of writing are being steadily pursued, seem fully to justify Lister's concluding words:

"Supposing these results to be trustworthy (and the record of them bears the stamp of authenticity), I need scarcely point out to a meeting like the present their transcendent importance as bearing upon the origin of infective diseases, and their modifications as exhibited in epidemics."

By the time this address was corrected for the press, April 1881, Pasteur had published his method of attenuation of the virus of chicken cholera. A short account of it was added in a postscript, and the various explanations then current were very briefly compared. This subject was outside Lister's special line of investigation, and therefore requires no mention here. The whole paper is a useful landmark in the field of bacteriological advance.

The rapidity of this advance may be gathered from what occurred when the Seventh International Medical Congress met the following year, 1881, in London. It was a memorable occasion. Over three thousand members, with wives and families on pleasure bent, flocked from all parts of the world, and brightened up the deserted city in the sweltering early days of August. Sir William Jenner took the chair at the first meeting, to introduce the President, Sir James Paget. Through their influence the patronage of the Queen had been obtained; and the Congress was opened by the Prince of Wales, by whose side was Frederick Crown Prince of Prussia.

After ten long years the bitter feelings between the French and the Germans had not subsided, and though they could meet in scientific debate and speak of one another, in public at least, with politeness, the social barrier remained, and those who entertained them, as Lister did, were forced to invite them on different days. The slowness with which such wounds are healed is a matter for sad reflection at the present day. The vaunted brotherhood of science is now spoken of less confidently than hopefully, and prophecies such as that of Sir William Jenner seem less likely than ever to be fulfilled:

"We have been told that commerce is the golden girdle of the world, binding men and nations together by common interests and a common aim. But science binds men and nations together with a girdle the links of which are far stronger, more durable, and more precious than are the links of the golden girdle of commerce. Knowledge is far more precious than gold.

> Who loves not knowledge? who shall rail
> Against her beauty? Who shall fix
> Her pillars?

With every increase in the world's stock of gold, the metal loses something of its value, while every addition to the world's store of scientific truth adds to the value it already had, and is a stepping-stone to the acquisition of more."

An unusual number of really distinguished men, men whose names are historical, attended the Congress, as may be gathered from the fact that the six general addresses were entrusted to Virchow, Raynaud,[1] Volkmann, Pasteur,

[1] Raynaud was prevented by illness from attending.

Billings and Huxley. Many more might be mentioned, and much might be said about this exceptionally interesting Congress, but attention must not be diverted from the incidents in which Lister was specially concerned.

Volkmann opened the fifth general meeting with an address on the advances of surgery during the last ten years. Enough has already been said of his views and of his eloquence to suggest how he would treat the subject. One rather rhetorical passage may perhaps be quoted from his opening sentences:

"England may be proud that it was one of her sons whose name is indissolubly bound up with this greatest advance that Surgery has ever made. The other nations may hand him the wreath without envy. For the long and quiet labour which made possible the ripening of the harvest we are now gathering so quickly and so richly, has been completely international, and in this labour France and Germany have equally borne their share. And no one has recognized the important part played by his fellow-workers more than Mr. Joseph Lister." [1]

Volkmann's brilliant address was followed by a fascinating discourse on "Vaccination in Relation to Chicken-Cholera and Splenic Fever" by Pasteur,[2] whose presence, as Lister said, was one of the glories of the Congress and who gave them the great privilege of hearing from his own lips, at the earliest possible date, an account of those researches which, whether we regard them in respect of the philosophical character of their method, or the beneficent application of their results, must ever rank among the finest achievements of science.

This important paper was afterwards printed by our Local Government Board, and issued as a parliamentary paper. The attenuation of viruses belongs to Pasteur's life not to Lister's. We must therefore be content with emphasizing its epoch-making character and quoting a few words:

"By your hearty reception, you have revived the feeling of pleasure I felt when your great surgeon Lister said that my publications on the lactic fermentation in 1857 were the starting point of his thoughts on his invaluable surgical method; you have revived the

[1] *Trans. Internat. Med. Congress*, London, 1881, vol. i. p. 75.

[2] *Loc. cit.* p. 85.

joy I experienced when our eminent physician Dr. Davaine asserted that his work on charbon was inspired by my studies in 1861 on the butyric fermentation and the organisms that are characteristic of it."

Lister took part in two discussions: one in the Pathological and the other in the Surgical Section.

In the former he opened a debate "On the relations of minute organisms to unhealthy processes arising in wounds and to inflammation in general." [1] The line he took was novel and unexpected. It seemed as if he were setting himself to restrain a spirit he had himself raised. It had been his part to prove that the suppuration of wounds was caused by micro-organisms; and by introducing the antiseptic treatment to banish inflammation from wounds made by the surgeon. "Such results," he said, "proceeding from a mode of treatment designed especially to exclude bacteria, may suggest the idea that all inflammation is caused by micro-organisms, and that suppuration, whether acute or chronic, is always due to similar agencies."

The very success of the antiseptic treatment favoured this doctrine. But he thought it "a very exaggerated view of the matter, and a view which may tend to have a serious influence upon our practice." It threw doubts upon the efficacy of the time-honoured doctrine of counter-irritation, and on his own teaching that inflammation may be brought about through the influence of the nervous system.

This warning note was the text of his speech. He vindicated "the ancient principles of John Hunter with regard to sympathy"—"the special sympathy which, as John Hunter pointed out, exists between an internal organ and the integument nearest to that organ"; and he illustrated his argument by such simple facts as that sneezing can be stopped by pressing the end of the nose till it hurts, or itching removed by rubbing round but not actually on the place where a fly has settled. He described the case of a healthy girl, who taking her broth—'kail' as the Scotch call it—very voraciously, swallowed the bud of the kail plant,

[1] *Trans. Internat. Med. Congress*, London, 1881, vol. i. p. 311; *Collected Papers*, vol. i. p. 399.

which became impacted in the upper part of her oesophagus. For three days it remained there, but though she had "a curious yearning sort of uneasiness in the epigastrium," she had no true sense of hunger. "By virtue of the sympathy existing between the oesophagus and the stomach, the sensation, or nervous action, which constitutes hunger had been prevented from occurring."

This nervous action he called physiological counter-irritation. And he asked, if pathological counter-irritation be discredited, how the removal of pain and the cure of inflammation by means of the actual cautery are to be accounted for; how, the inflammation of an internal organ following exposure to a chill?

Lister protested against a statement made shortly before by an able surgeon that counter-irritation might be regarded as a thing of the past, as something exploded; and time has justified the protest, for blisters and rubefacients and other counter-irritants still hold their own, though the cause for their efficiency may be differently explained. He never changed his mind about the influence of the nervous system upon inflammation, and, although this difficult subject has been made clearer by subsequent discoveries, it would be rash to say that his teaching has been proved to be incorrect.

On the afternoon of the same day Koch gave a demonstration. He showed, on the screen, magic-lantern micro-photographs, as they were then called, of sections made by himself illustrating the effects of micro-organisms on various diseased tissues. On another occasion at King's College, he gave a second demonstration, illustrating practically his methods of cultivating and isolating micro-organisms. The events of that afternoon are apparently not recorded in the transactions of the Congress.

Koch's plan of employing solid instead of fluid media for cultivating and obtaining pure cultures of micro-organisms at once superseded Lister's, and completely revolutionized the study of these low forms of life. A small quantity of the material containing the mixture of organisms it was desired to separate from one another was well shaken up in

a nutritive gelatine medium, the composition of which was so devised that it melted at a temperature not sufficiently high to kill the micro-organisms, but solidified at a temperature not too low for their active development. When growth took place the organisms produced separate colonies and were not evenly diffused as was the case where a fluid medium was used. These colonies could be picked out with a needle and transferred to a fresh vessel of the cultivating medium and, in this way, if not at the first attempt, at all events after one or two transplantations, pure cultures could always be obtained. Solid media whether natural, such as the surface of a sliced potato, or artificial, such as that just described, are invaluable for the study of the physiology of micro-organisms. The only reason why Lister did not employ them was because he was no longer engaged in this line of investigation, which passed more and more into the hands of specialists.

Both Lister and Pasteur were present at this striking demonstration. It was memorable for its great interest and for the remarkable way in which Koch's words were instantly translated from German into pure English by the learned Dr. Frank Payne of St. Thomas's Hospital, and also for an incident that much gratified Lister. He succeeded in bringing Pasteur and Koch together, which was in itself a triumph, as Pasteur could never forget the war; and, as he took Koch's hand, he exclaimed: C'est un grand progrès, Monsieur." [1]

The greatest surgical event of the Congress was a full-dress debate on the causes of failure in obtaining primary union in operation wounds and on the methods of treatment best calculated to secure it.[2]

Savory led off with a paper in which he regretted having the rôle of Cassandra allotted to him, and referred to his Cork address as still the epitome of his creed. He did indeed pay Lister one half-hearted compliment:

"Surgical wards, not long ago hotbeds of poison, are now made fairly safe for patients. Need I say to whom the chief glory of this

[1] *Collected Papers*, vol. ii. 332.

[2] *Trans. Internat. Med. Congress*, London, 1881, vol. ii. p. 345.

reformation is due? But while no doubt some startling novelty of practice was necessary, or at least greatly advantageous to this end, yet I cannot doubt that the same end might have been reached by an adequate improvement in simple sanitary arrangements."

Savory never changed his views on this question. Thus he said:

"The claims of any particular plan of practice to surpassing excellence can be established only when that particular plan can show results better than the best that can be obtained by any other means. And again I declare that this has not yet been done." And further on: "A particular form of ligature is applied to an artery by an operation performed with special precautions. Then dead and pickled tissue is reanimated, and henceforth lives happily in communion with the vessel. Then the cry is, 'See here! Show this if you can by other means.' Well, the same experiment is tried by other means, and the same result ensues, only then it is not painted in such glowing colours. Then we don't talk of restoration to life. We explain it by changes which have long since been described." He concluded with these words. "Who will define a septic from an aseptic state? Is it then, after all, so far as wounds are concerned, merely a question of degree? For the present I, at least, am inclined to think so."

Foreign surgeons must have wondered at this out of date statement of the case for the opposition; and still more when Sampson Gamgee, Lister's fellow student and former friend, an ingenious surgeon, but a disappointed man, maintained, in the course of a dismal restatement of antiquated views, that Lister obtained no better results than those of many others and certainly not superior to his own.

The discussion was raised to a higher level by a thoughtful paper by Verneuil of Paris and was well maintained by Volkmann, Esmarch, Letiévant of Lyons and others, and then Lister wound up the debate in one of the most important speeches he ever made, not only on account of its close reasoning, but because of the new matter introduced and the foreshadowing of much that Metchnikoff subsequently explained. Possibly, at the time, it may have been difficult at first to see the application to the subject of debate—the primary union of wounds, for this did not appear till towards the end. At the present day it well repays perusal;

and the following epitome should not deter the reader from studying in the original one of Lister's best and most characteristic discourses.[1]

He began by expressing surprise that a secondary place was still assigned by many to antiseptic measures in surgery, and accounting for the fact by the brilliant results sometimes obtained without them, notably in abdominal surgery and especially in ovariotomy. This success he had previously explained [2] by the anatomical peculiarities and the high vitality of the peritoneum. But now he gave further reasons why the peritoneum should be able to set up a better resistance to the attacks of micro-organisms than other parts of the body. His recent experiments had shown that, contrary to the common belief, blood serum is not a favourable nidus for the growth of bacteria. These experiments suggested indeed that blood serum even exercised an inhibitory action on isolated bacteria, though if masses of them were introduced they might grow readily. He was not able to state positively what was the nature of this bactericidal property of blood serum though he offered two possible explanations. But whatever the explanation might be, he said, the fact remained: and he added, "Applying this knowledge to the discussion of ovariotomy performed without antiseptic precautions, the question naturally suggests itself whether in many cases any septic organisms have really been introduced into the peritoneal cavity either from air or from water, in a condition capable of developing in the effused serum." By which he meant that a single bacterium here and there might have no chance of survival, in such an uncongenial medium.

The next step in the argument was to show that an undisturbed blood-clot is an even less favourable nidus than serum for bacterial growth. Experiments were described, which, on account of the Cruelty to Animals Act, he had performed abroad, availing himself of the hospitality of Professor Toussaint of Toulouse. Short pieces of glass tube,

[1] *Lancet*, 1881, vol. ii. pp. 863, 901; *Trans. Internat. Med. Congress*, London, 1881, vol. ii. p. 369; *Collected Papers*, vol. ii. p. 275.

[2] See page 287.

each containing a morsel of linen which had received $\frac{1}{20}$ minim of septic liquid, were introduced into four separate portions of the jugular vein of an ass; each of these portions of the vein being shut off by the application of two ligatures one above and one below the glass tube. They thus formed "four venous compartments or capsules quite distinct from one another, and consisting of healthy tissue at the outset."

After three days, when the animal was killed, putrefaction had occurred in each compartment, the degree varying with the amount of dilution of the septic fluid. The wall of the vein, somewhat thickened by inflammation, was protected from the inroads of the bacteria by a layer of what looked like healthy clot, though, on microscopic examination, it proved to be peopled with new corpuscles. Now Lister had never succeeded in getting the white corpuscles of the blood to multiply outside the body, though he had seen them undergoing amoebic movements some days after the blood was shed. Hence he concluded that the new cells in the clot must be of a different nature from the white corpuscles they so closely resembled, and must have migrated into the clot from the surrounding tissues,—a view which was supported by the discovery of a multitude of similar corpuscles in microscopical sections of the walls of the veins. These corpuscles we of course at once now recognize as Metchnikoff's phagocytes. "Thus," he said, "the experiment affords very striking proof of the power of an undisturbed healthy coagulum in the vicinity of living tissues to resist the development of putrefactive bacteria, even when present in a highly concentrated form; while we have, as I believe, an explanation of this power in the multitude of new living elements with which the clot was peopled."

There is something almost prophetic of Metchnikoff's discoveries in his application of these facts to explain an occasional complication of ovariotomy and other abdominal operations,—the formation of a localized septic abscess in the lower part of the pelvis, effectually cut off from the rest of the peritoneal cavity by inflammatory adhesions.

"And here," he says, "the high vital energy of the peritoneum would come into play. We have seen how rapidly a wound in the

peritoneum may heal, and this rapid healing is, in other words, the rapid peopling of the lymph in the wound with vigorous new living elements. For, whatever view may be taken as to the source of these new corpuscles, certain it is that the organization of lymph proceeds more rapidly in proportion as the wounded tissues are in a more vigorous condition." And again: "This lymph, being rapidly organized through the high vital energy of the peritoneum, would oppose an effectual barrier to the spreading of bacteric development should it extend to the surface of the clot."

From the exceptional case of ovariotomy he then passed to more general considerations, and showed how this new principle would explain the occasional organization of a clot, even a large one, in any part of the body, although it might be covered by a septic dressing. And then he turned to the question of healing by first intention.

"Our principle seems, however, to find its widest application in aiding to explain the possibility of union by the first intention without the use of any antiseptic means, nay, in spite of the application of septic ones. For such is, in truth, the apparently cleanly water-dressing. As certainly as we remove it from a wound after the lapse of twenty-four hours, do we find that the diluted blood serum which then soaks the lint has a putrid smell, implying that it contains septic ferments such as would assuredly act effectively upon blood outside the body. And yet, in the not uncommon case of the occurrence of primary union under such treatment, putrefaction fails to spread into the wound; for if it did so it would inevitably provoke suppuration."

Then came the final stage of the argument. If the clot derived its bactericidal properties from the adjacent living tissues it is obvious that the thinner the clot the more powerful these properties must be. Healing by first intention only occurs when the sides of the wound are in accurate apposition, under which circumstances the whole of the hardly appreciable thin layer of intervening clot quickly becomes invaded with these new cells—phagocytes—so inimical to bacterial life. The mystery is thus explained. "And here our new principle comes to our aid, when we learn that the clot itself, as it becomes organized, acquires the defensive property which remained to be accounted for."

But though the rationale of healing by first intention was thus explained, and the means employed by the old surgeons were justified by the new principle, it was necessary to impress two other points of practical importance upon his audience. First, that under old conditions unfavourable results were common because the amount of septic matter introduced was too large to be overcome by the new cells in the clot. Secondly, that under aseptic methods healing by first intention was no longer of importance, because the protection it afforded was no longer necessary in order to obtain the one thing needful, healing without inflammation —healing without that "unhealthy action," which is only caused by decomposition. As far as he was concerned, in many serious cases, such as the opening of joints, he systematically abstained from closing the wound completely, in order to provide for drainage, thus rendering healing by first intention impossible.

"In other words, I abstain from the only means which would have afforded hope of success without antiseptic treatment, and I adopt means which, without antiseptic treatment, must infallibly lead to disaster." "If we suffer ourselves," he said, "to be drawn aside from the strict antiseptic principle, we shall not only subject our patients to the risk of the old disasters, but we shall be compelled to withhold from them the benefit of valuable procedures which strict antiseptic management alone can warrant."

No more was said about healing by first intention. He closed with two parting shots at his opponents.

It was constantly said that perfect cleanliness gave just as good results as antiseptic treatment. Esmarch had that day advocated his well-known "Dauer-Verband," or permanent dressing. "What can be more dirty," Lister asked, "in the ordinary acceptation of the term, than a wound left covered up with the same dressing for weeks together, the original blood and serum remaining upon it intact under this 'Dauer-Verband'? Yet it is surgically clean because it is aseptic. On the other hand, the aesthetically cleanly water-dressing is surgically dirty, because it contains elements which give rise to septic changes in wounds."

His concluding statement had often been made before but

had apparently fallen on deaf ears. "The old objection has been revived that antiseptic treatment leads the surgeon to concentrate his attention upon local measures, to the neglect of general hygienic arrangements and a due consideration for the constitutional state of the patient before subjecting him to an operation." Both parts of the charge, he said, were unwarranted by the facts: but as regards the first, experience showed that the mere question of cubic space per patient became unimportant under an antiseptic regime; and as regards the second, "the truth is, that the suppression of the septic element enlarges the capabilities of surgery in the constitutional direction no less than in the local; and enables us to extend the benefits of needed operations to patients whose constitutions are so enfeebled by age or vitiated by disease that without strict antiseptic treatment no prudent surgeon would venture to meddle with them."

The two communications to the Congress were corrected for the press in the Engadine and Tyrol. If the wearied reader complains of the space devoted to them, he will find some justification in the following letter:

"CORTINA 22nd Sept 1881.

MY DEAR ARTHUR,

Thy welcome letter, telling of thy enjoyment of the York meeting [that of the British Association] and of the kind reception of allusions made there to my work, ought to have been answered before now. But strange as it may seem, one of the two communications which I made to the Congress, and of which I gave thee a summary in no very long time in the Botanic Gardens when I saw thee last, is only within the last few minutes finished even in rough copy. I have not yet touched the one made to the Pathological Section; but this will not, I hope, take long, as I have a short-hand writer's report of it and it may be published very much as it was given. But the one at the Surgical Section, on the treatment of wounds, given extempore and at high pressure for time and including a reference to several new observations of a somewhat intricate sort and at a critical period of the antiseptic question, has given me an amount of trouble such as I had not at all anticipated. Now my doubt is whether anybody will read it! At all events the burden is off my mind as I write these lines to thee. We shall have been here a fortnight to-morrow, and a better place for our purpose could hardly have been found. Though warmer than the Engadine,

which was getting decidedly too cold when we left it, we have found Cortina at this season fresh and bracing. Its glorious Dolomite mountains have afforded us constant new excursions daily; and as we have not found walks of full twelve miles too much for either of us, we have been able to get well up upon the hills so as to have magnificent views. Our afternoons have been always sacred to enjoyment; and as I have the happy faculty of being able to throw off all thoughts of work for the time being, the holiday is answering its purpose well as such. And really, though of course it has been a self-denial to be working, yet doing so has perhaps increased the zest of the afternoon's pleasure; and certainly we have felt it a most satisfactory thing to learn to know a place like this, as one can only do by staying a considerable time at it . . . I must say I shall be pleased if the Pathological affair is really ready for the printer by the time we are compelled to travel homewards."

CHAPTER XXVII

ANTISEPTIC AND ASEPTIC SURGERY

BARELY half a century has passed since the antiseptic system was placed in a concrete form before the world, but already it is spoken of as out of date, and Lister's writings are seldom studied in the original. The stately volumes in which the "Collected Papers" are interred are available only for the few. Modern surgeons revere them as classics, valuable chiefly as relics and as records of the stages leading up to the present state of enlightenment; but they do not read them. This is much to be regretted, not only because they are full of instruction at the present day, but because they give a consecutive story of his work, and an insight into his manner of thought such as no mere extracts can supply.

It is the common lot. Each living generation is apt to mingle pity with gratitude for the efforts of its predecessors; and to-day those who call themselves aseptic surgeons speak almost scornfully of those who still carry out Lister's treatment in its entirety.

So much stress has been laid upon supposed essential differences between Aseptic and Antiseptic surgery that it is necessary to enquire whether any such antagonism between the two methods actually exists; and in order to make the matter clear, we must always keep in mind the groundwork upon which the antiseptic system was originally based.

The antiseptic system aimed at destroying the germs by chemical agency, either before they gained access to a wound at the time of its infliction, or so soon afterwards that they had no chance of developing and multiplying; and, this

end having been attained, it further aimed at preventing by means of chemical antiseptics the access of germs to the wound until the process of healing was complete.

The problem as thus stated sounds simple, and so it appeared to be in the early days. But, even from the first, one great complication was apparent. Lister recognized the power of the living tissues to control the growth of micro-organisms, and the importance of not interfering with the vitality of the tissues by any harmful agency whatever. Therefore he felt bound to reduce the strength of the chemical substances which he employed to the minimum consistent with efficiency.

This destructive influence of the living tissues upon micro-organisms attracted more and more attention as its *modus operandi* was discovered by Lister himself and by Metchnikoff and by others. Increasing confidence was placed in it, and objections were raised against the application of any chemical antiseptics at all to wounds, because they interfered with it. The followers of von Bergmann held that if the organisms falling on an operation wound were washed away as far as possible by irrigation with a perfectly unirritating fluid like normal salt-solution, or if a dirty compound fracture were thoroughly scrubbed with a nail brush and a plentiful supply of this bland liquid, the living tissues might be trusted to deal with the few micro-organisms left in contact with them.

So great did the prejudice against chemical antiseptics become, that the new school sought to banish them even from their dressings, applying only materials, such as cotton-wool or gauze, which had been rendered sterile by super-heating, and which kept out the germs by mere filtration. In this they were following a method adopted for a short time by Lister about 1870,[1] only he rendered his cotton wool aseptic with ether and carbolic acid, both of which, being volatile, soon disappeared by evaporation. He discarded this plan because he thought it less convenient and less trustworthy than the use of an antiseptic dressing. It

[1] His method of procedure is fully described in the Plymouth Address. *Collected Papers*, vol. ii. pp. 176, 177.

cannot however be denied that by taking extraordinary pains, and devoting very great attention to details, excellent results were obtained by the new method.

Meantime other discoveries besides that of the germicidal action of the phagocytes in lymph, blood-clot, and the living tissues, turned the attention of many away from Lister's original teaching and forced them to proclaim themselves asepticists.

1st. The differentiation of pathogenic (disease-producing) from non-pathogenic micro-organisms, and the demonstration that the pathogenic germs, though common in water and abundant in decaying matter of the soil, are comparatively scarce in the air, which was still looked upon as the usual source of infection of wounds.

2nd. The discovery of micrococci[1] in the discharges of a certain number of wounds healing without inflammation—that is pursuing what is called an aseptic course—under an antiseptic dressing. This seemed at first sight to upset the whole of Lister's argument. It was said that though he tried to keep out all organisms, he failed in the attempt, and yet claimed to obtain better results than other people. If his claim were true there must therefore be some other cause for his success.

It is difficult to convince a stubborn mind that this is a *non sequitur*, by pointing out that, when such organisms are found, they are harmless cocci which have escaped destruction during the preliminary purification of the skin and which may never have come in contact with the mild antiseptic in the dressing; or by showing experimentally that with extra precautions and more frequent changing of the dressings it is almost always possible to keep a wound absolutely free even from these innocuous germs. And, after all, the argument with regard to the relative merits of antiseptics and asepsis remains unaffected; for even if it be granted that these mild infections are more likely to occur when no chemical antiseptics are employed, the fact remains that wounds do heal without inflammation and apparently equally well whether harmless cocci are present or not.

[1] As distinguished from rod-shaped bacteria.

3rd. The discovery of micro-organisms in unopened abscesses, which suggested the criticism that it was futile to make frantic efforts to keep them out of surgical or accidental wounds, seeing that they clearly had other means of access to the living body.

This criticism was met by pointing to the well-established fact that the healthy living tissues, unlike the walls of an abscess, are invariably sterile, and it is in healthy living tissues that surgery for the most part is conducted.

4th. The discovery of the extraordinary resisting powers of the spores of some of the most dangerous micro-organisms, such as those of anthrax and tetanus. This was unexpected and disconcerting. Pure liquefied carbolic acid does not kill the spores of the tetanus bacillus till it has acted upon them for a considerable time; and they withstand the action of a 5 % solution for 12 or 15 hours. It is therefore evidently impossible that they should be destroyed during the short time that it would be safe to allow a potent antiseptic to act upon a wound. Would it not be better then, urged the new school, to trust altogether to the unimpaired action of the tissues? and they added that a strong antiseptic like carbolic acid causes some superficial sloughing (or death of the tissues) and that there is no soil so favourable for the germinating of spores as a slough.

The answer to this objection is partly practical, partly theoretical. From the practical point of view it may be stated that the introduction of antiseptics was, in fact, followed by the almost total disappearance from civil practice of tetanus, spreading gangrene, and other diseases caused by these very resisting spores. From the theoretical standpoint it may be argued that these deadly organisms are mostly anaerobic and that their spores require a more or less airless, moist, warm, alkaline material for their active development. Such a nidus is not supplied by the insignificant superficial slough caused by pure carbolic acid, which, moreover, soon becomes peopled by active defensive phagocytes. On the other hand, if the pus-producing organisms are allowed to have their way, they quickly give rise to a copious and constantly extending slough, containing few,

if any, phagocytes, and these in a state of exhaustion, in fact an ideal medium for the germination and propagation of the spores.

5th. The latest of these unsettling discoveries, which really has no place here, was made after Lister's death. It has been shown that if a cultivation of micro-organisms is introduced under the skin they may be found in a very few minutes in the lymph stream, the lymphatic glands and the blood. What is the use, it may be asked, of attempting to destroy organisms in the wound when in nine cases out of ten they must have entered the circulation before the antiseptic can be applied?

This is a specious argument. But, passing by the fact that a subcutaneous injection has little resemblance to a gaping accidental wound, the observations of the bacteriologists themselves fortunately supply the answer. Phagocytes are not confined to the muscular and connective tissues in which most wounds occur. Cells of the same order occupy the lymphatic glands, the liver, the spleen and the bone-marrow. Germs that have entered the circulation are carried at lightning speed, round and round amongst these germ-destroyers, and, unless the dose of poison be highly concentrated, it is unlikely that those which have escaped what may be compared to the sword of Jehu will not be slain by the sword of Elisha.

There is, moreover, no evidence that reinfection of a wound ever takes place by germs that have once entered the circulation. They may of course give rise to a general blood-poisoning, but there is no reason to think that they can cause suppuration in the wound through which they have found an entrance.

Writing in 1891, Lister referred to the disappearance, under antiseptic treatment, of diseases like erysipelas and hospital gangrene, which were in early days not spoken of as septic diseases because they were not accompanied by the foul smell of putrefaction,—and then continued:

"Thus the attempt to exclude microbes entirely from wounds was followed by results which more than fulfilled the highest hopes entertained of it. Yet the advance of knowledge has shown that

to carry out such an idea in its entirety is on the one hand impossible, and on the other hand unnecessary.

It has been ascertained that many common bacteric forms produce spores which resist for a long time the germicidal power of all known agents which could be used in operations. Hence to exclude living microbes entirely from wounds is an impossibility.

It is, on the other hand, happily unnecessary; and that for more reasons than one. In the first place, it appears that none of the bacteria which can cause mischief in wounds are of the spore-bearing kinds,* while the sporeless bacteria, such as the various streptococci and staphylococci and the *Bacillus pyocyaneus*, have been shown by the most careful recent investigations to be deprived of life within a minute by a 1 to 20 watery solution of carbolic acid, the agent which we have always trusted for the purification of sponges and instruments, the hands of the operator, and the integument of the patient at the seat of operation." [1]

* "An exception was once met with by von Volkmann who observed anthrax result from the use of the catgut ligature, prepared, no doubt, from the intestine of a sheep that had died of that disease. But this risk having been pointed out, care is now taken to treat the catgut in such a way as to make such an occurrence impossible."

Thus he frankly admitted that a certain number of the beliefs upon which his system was founded had had to be modified or even discarded. But it is to be regretted that so much should have been made of this, and that in the feud that has arisen between the advocates of antiseptics and aseptics intemperate language should have been used. Such was never employed by von Bergmann or by Lister. There ought not to have been a contest at all; for the two systems are not really opposed to one another. Aseptic surgery is admitted by all to be the ideal, but the ideal has not been attained. What is called aseptic surgery is only a modification of what was called antiseptic surgery Chemical antiseptics play a less important part in the former than in the latter, and the germicidal properties of heat are more called in aid. But both have the same end in view: namely, the exclusion from wounds of pathogenic microbes in such a condition that they have a chance of growing there. The pity of it is that, for the moment, surgeons appear to feel bound to range themselves either on one side or the other.

[1] *Festschrift, Rudolf Virchow*, Berlin, A. Hirschwald, 1891, Bd. iii. s. 262. *Collected Papers*, vol. ii. p. 341.

Students nowadays seldom have the chance of watching the successful practice of a surgeon working with the simple means which Lister employed. In real truth they never have the opportunity. Even Sir Watson Cheyne, perhaps Lister's most faithful follower in London, is only to be seen in the most modern of modern theatres, surrounded by all the complicated refinements without the help of which the spectator may well assume that his results would be less brilliant. Since King's College Hospital was demolished and transferred to Camberwell there is not an old-fashioned theatre to be found in London. It was more instructive to see Lister in that dingy old building obtaining results as good as, or perhaps better than, those of which any modern surgeon can boast; though it is easy to understand the statement attributed to a German surgeon on seeing him amongst these primitive surroundings, that he was the worst practitioner of the doctrines which he preached.

The contrast between the two methods will best be shown by recalling the picture of Lister at his work during the last years of his practice—a picture which may have some value in future days—and comparing it with that of a typical aseptic surgeon of to-day.

If Lister had to perform an operation in a private house, no previous preparations were made except the provision of trays and basins containing carbolic acid lotion of two strengths, 1 to 20 and 1 to 40, and even these lotions he often brought to the scene of action himself. On his arrival, the instruments, which had been carefully washed but not specially sterilized after the last operation, were placed in a tray of 1 to 20 lotion, the strength of which was slightly mitigated just before the operation began by adding a small quantity of water. As Lister was punctiliously deliberate in his preliminary arrangements the instruments lay in the carbolic acid lotion for twenty minutes or half-an-hour before they were actually used.

The sponges were placed in a 1 to 40 lotion. They had been prepared in what he called "a somewhat rough and ready way." "I put the sponges after an operation into a tank of water, and let them putrefy there. The fibrine,

which clings among the pores of the sponges, becomes liquefied by putrefaction. They can then be washed thoroughly clean of their fibrine, and the washing is continued until they no longer give a red colour to water. They are then put into 1 in 20 carbolic acid lotion and kept there." [1]

When everything was precisely in the most convenient position, the patient was brought in. The seat of operation had not been specially cleansed. "It is not needful," he said, "to apply an antiseptic lotion for hours together, as is sometimes done; a few minutes' action of the 1 in 20 carbolic lotion is really sufficient; while its long-continued operation sometimes produces troublesome irritation." This simple preparation was often performed whilst the chloroform—it was always chloroform, not ether—was being administered. Lister deprecated the use of soap and water or anything that would remove the greasy matter of the skin, because "carbolic acid has a powerful affinity for the epidermis, penetrating deeply into its substance; and it mingles with the fatty materials in any proportion."

He then took off his coat, turned up his shirt sleeves, pinned an ordinary unsterilized huckaback towel over his waistcoat (for his own protection not that of the patient) and washed his hands in 1 to 20 lotion, or even what he called "the strong lotion" (1 to 20 carbolic acid in 1 to 500 sublimate lotion), an ordeal that few of his adherents could endure. Towels wrung out of 1 to 20 carbolic acid lotion were arranged over thin mackintosh round the seat of operation. He wore no mask or gloves. Silence was supposed to be maintained as long as the wound was exposed, but the rule was by no means strictly adhered to.

During the operation, which was seldom short, for Lister was a slow operator, the hands of everyone concerned were frequently dipped in 1 to 40 lotion. The sponges, when soiled, were washed in cold and hot water and replaced in the 1 to 40 lotion. Thus, although they were forcibly wrung out before being used again, a small amount of carbolic acid was constantly conveyed to the wound; and, as a safeguard

[1] "An Address on the Antiseptic Management of Wounds," *Brit. Med. Journ.* 1893, vol. i. pp. 161, 277, 337. *Collected Papers*, vol. ii. p. 353.

against any gross contamination owing to the carelessness of assistants or nurses, he used to wash the wound with 1 to 40 before sewing it up. But he doubted the necessity of this precaution and sometimes omitted it.[1]

Bleeding vessels were tied with his own specially prepared sulpho-chromic catgut,[2] brought dry to the house and simply steeped for about half-an-hour in 1 to 20 lotion. The sutures were silver wire, silkworm gut, or sometimes fine silk or catgut. They were only rendered aseptic by means of carbolic acid.

The dressing was a thick pad of cyanide gauze[3] covered by a mass of salicylic wool. The part of the gauze next the wound was wrung out of 1 to 40 lotion.

Hospital operations were conducted exactly in the same way except that the sponges were more carefully prepared. They were "washed well with soap and water, and afterwards with soda; then thoroughly washed again with water, and finally, after drying, put to steep in 1 in 20 carbolic solution till they were again required for use."[4]

This simple procedure requires no long description. As no complicated apparatus was needed, it could be carried out as well in a cottage as in a hospital. The chemical antiseptic applied to the hands, and the antiseptic towels surrounding the field of operation, were effectual safeguards against carelessness or incompetence of assistants, and against imperfections in the surroundings.

What the student saw his teacher do, he knew that he could carry out himself on retiring to a small practice in town or country. He had no excuse for saying that some essential machinery behind the scenes, of which he knew nothing, was beyond his reach, or that such a complicated system of treatment was impossible and in his opinion unnecessary in the pure air of the country.

[1] After the valuable properties of corrosive sublimate became known, Lister, at various times used sublimate lotions of different strengths instead of carbolic acid lotions during the performance of operations, but he never gave up the use of carbolic acid for purifying the skin and the instruments; and after many comparative trials of the convenience of the two antiseptics, he returned to the practice described in the text.

[2] See page 238. [3] See page 302. [4] *Collected Papers*, vol. ii. p. 353.

But, unfortunately, there was one practical objection to carbolic acid as Lister used it. It makes the hands rough and numb, especially when cold east winds are blowing. You cannot get away from chapped hands, and when the inconvenience was obviated by a system which, besides having the attraction of novelty, was supported by reasonable arguments, this small matter often turned the scale in favour of the new system, especially when other more or less effectual ways of purifying the hands were suggested that involved irritation at all.

It will take longer to do justice to the aseptic surgeon of 1917. Schimmelbusch's modest volume,[1] published in 1892, describing von Bergmann's practice at that time, has been followed by many larger books describing in vastly greater detail the edifice that has been raised upon these humble foundations. In those days it was thought immodest for a nurse to bare her arms above the elbow, and the three figures who appear on page 152, and look so proud, might well blush if they could visit a modern operating theatre.

Naturally, when so much depends upon aseptic surroundings, it is preferred that all operations should be performed in aseptic theatres. But this is not always possible, and, in order to make a good comparison, we will first suppose that the operation has to take place in a private house. It will probably have been arranged for the nurse to prepare the room by taking up the carpet, removing curtains and pictures and most of the furniture, and cleansing it with some antiseptic. She will have taken with her a large sterilizer, and several tins or nickel-plated drums which, with their contents, have been sterilized in high-pressure steam by tradesmen who carry out this process on a large scale, but over whom the surgeon has no personal control. The tins or drums contain three or four linen overalls, caps and masks, many dozen gauze and wool swabs and a large quantity of plain gauze and cotton-wool as well as bandages and

[1] C. Schimmelbusch, *Anleitung zur aseptischen Wundbehandlung*. Berlin, A. Hirschwald, 1892. *The Aseptic Treatment of Wounds*, by Dr. C. Schimmelbusch, Translated from the 2nd German edition by Alfred Theodore Rake, M.B. London, H. K. Lewis, 1894.

towels. If he is not sure that the nurse has provided these, the surgeon must take them himself. He is also provided with a good supply of sterilized salt-solution of double strength, to mix with the boiled water which he expects to find in abundance, both hot and cold. The responsibility—no small one—that the boiled water has been placed in aseptic vessels and securely protected from subsequent infection, rests with the nurse, and it will be observed that in this, as in other matters, highly trained nurses are essential to success.

On his arrival he puts out the instruments and several pairs of india-rubber gloves, which are then boiled in the sterilizer for some time and placed on trays or other suitable receptacles containing boiled water, or they may if preferred be used dry. There is no merit in the boiled water except that the instruments are kept more or less clean if they are replaced in it. It takes the place of Lister's carbolic acid lotion which not only cleansed the instruments but kept them aseptic. Edged tools such as knives, scissors and needles are usually sterilized by dipping in pure liquefied carbolic acid, and then transferring them to methylated spirit in which they are kept during the operation. Ligatures and sutures, after boiling, are placed in boiled water or alcohol.

The surgeons, assistants and nurses are now clad in their sterilized overalls, and caps and masks are put on, covering either the mouth only, or both mouth and nose. The surgeon and assistants then complete the washing of their hands, which have been previously well scrubbed in soap and water, by scrubbing them again either with water or with methylated spirit or biniodide of mercury and spirit, or by adopting any of the numerous methods of skin-purification which may be in favour.

Meantime the patient has been brought in and is being anaesthetized. There are many ways of purifying the patient's skin. Till recently it was, if possible, begun one or sometimes two days before. It consisted in washing with soap and water, ether and turpentine, and then with a solution of corrosive sublimate or biniodide of mercury, but the use of the mercurial lotions was omitted by the most enthusiastic asepticists. Between the two washings usually recommended,

the part was packed up in sterilized gauze, and the cleansing process was repeated by the nurse on the operating table.

But at the present time another method is almost universally adopted. It is a true *antiseptic* method. No washing is done. If shaving is required, it must be a dry shave. The part is then simply painted with tincture of iodine, two or three times, a few minutes before the operation. The germicidal power of iodine has not yet been exactly estimated; but it has proved in practice to be remarkably efficient for this particular purpose. And it must be clear, even to lay readers, that if this plan is really successful, its advantages for operations of emergency are very great indeed. It must, however, be repeated that iodine is a chemical antiseptic.

The whole field of operation is then surrounded by dry sterilized linen cloths, which, as soon as the first incision has been made, are fastened by clips to the actual margins of the wound. Great watchfulness is necessary through the whole course of the operation to see that no unclean thing —that is, unclean from the bacteriological point of view— has access to these sterilized cloths, sleeves, gowns and gloves, and thence to the wound. As they are simply aseptic they are inert and afford no protection against infection.

The surgeon tries as far as possible not to touch the wound with anything except his instruments (which are frequently washed in boiled water), or with dry swabs which are discarded as soon as soiled. He puts his gloved hands into the wound as little as possible and washes them in boiled water from time to time. He is, or should be, fully conscious of the danger of gloves in aseptic surgery. A puncture may exist or may be caused during the operation; then if his hands have only been cleansed aseptically, organisms which have escaped from his sweat glands and hair follicles may collect in considerable quantities in the mixture of water and perspiration in the gloves and pass through the puncture into the wound.

Bleeding vessels are secured with catgut or fine silk or linen thread; in the former case the catgut is usually preserved in alcohol, and in the latter the ligatures are boiled before each operation.

At the end of the operation the wound is either simply sponged dry with sterilized swabs, or this is done after a preliminary douche of boiled water or salt-solution. If possible, greater attention is paid by the aseptic than the antiseptic surgeon to leaving the wound completely dry, so that only a minimum of clot may remain to be fortified or rendered antiseptic by the phagocytes that migrate into it. The smaller the clot, the greater proportion of phagocytes it will contain; and therefore the more potent will be its antiseptic properties. More is expected of it after an aseptic operation, because, not only are there likely to be more microbes, but their activity has not been interfered with as in the case of an antiseptic operation.

The sutures are silkworm gut, horsehair, or catgut.

The dressing is a pad of dry sterilized gauze and cotton-wool, applied in sufficient mass to prevent, if possible, any soakage through of blood or serum before the first changing of the dressing. If, however, soakage should take place, the dressing must be immediately changed, or extra packing with the sterilized dressing must be applied, till the surgeon arrives. This is to prevent septic infection through the moist track leading down to the wound; for the gauze and wool act as germ filters only when dry; they have no germicidal power. Lister's antiseptic gauze dressing, on the other hand, if applied according to his instructions, is supposed to be able to inhibit the growth of micro-organisms for 24 hours even if some soakage through should occur, provided this be not excessive in amount.

This then is the accepted routine in private practice. In hospitals the operation is conducted in the same way. Here, however, a state of luxurious refinement is often attained that is almost bewildering. In some clinics the audience, uncomfortably perched on marble seats, are shut off from the body of the theatre by glass screens. In others dressing-rooms, sometimes containing a bath, are provided for the surgeons, who strip to the skin and appear clothed only in sterilized garments, vest and jacket, white duck trousers, cap, mask, gloves and tennis shoes.

Here the student sees much of the sterilizing in progress,

and cannot fail to note its complicated character. Either in the theatre or an adjoining room are two or three large sterilizers in which instruments and gloves are frequently immersed. Piles of polished metal drums are at hand, from which the relays of sterilized garments, towels and swabs are taken. He also knows that, somewhere in the background is a mighty high-pressure steam sterilizer that he probably never has the chance of seeing, in which the dressings are sterilized wholesale, as they are by the firms which serve the private practitioner. What wonder if he says that, if all these things are essential, he must aim at something less perfect, and, when a full-fledged doctor, falls back on the old-fashioned surgery which is by no means yet completely forgotten? But it is more likely that he will simply adopt a few of the more striking but less important portions of a practice which depends for its success upon the most scrupulous attention to all its minutest details.

Any fair observer must allow that there is no radical difference between these two surgical methods, and that the word "aseptic," as now employed, is a misnomer, seeing that aseptic surgeons employ powerful antiseptic agencies, not excluding chemical antiseptics.

The idea underlying the modern practice is good, but it is not new. Nothing is gained by strong language either on one side or the other. It is painful to hear the modern school spoken of as heretics, or the old school as effete. Lister himself seldom referred to the matter in public, and then it was in words not of anger but of grief. Thus in 1893 he wrote:

"In conclusion, I may remark that it pleases me, as the years pass, to see the hope which I expressed at the International Congress in London eleven years ago in course of fulfilment, namely, that the use of the antiseptic system would gradually spread by leavening action throughout the world. At the same time, I am sorry sometimes to observe that unnecessary trouble is often taken in some directions while essential points are disregarded in others; so that, with the best intentions, the best results are not always obtained."[1]

[1] "An Address on the Antiseptic Management of Wounds," *Brit. Med. Journ.* 1893, vol. i. p. 339; *Collected Papers*, vol. ii. p. 364.

And again in 1908:

"I cannot but think it a happy circumstance that the substance which I employed first in endeavouring to apply the antiseptic principle should have been so admirably adapted for detergent purposes. And it has grieved me to learn that many surgeons have been led to substitute needlessly protracted and complicated measures for means so simple and efficient." [1]

An interesting note in the "common place book" dated November 6th, 1883, and headed "Antiseptic Operation without Antiseptic Contact," shows that Lister did not reject the new doctrine without putting it to the test.

"Four days ago I removed a lobulated subcutaneous fatty tumour from the shoulder of a woman aged 64, the tumour measuring about 2 inches by 1½ inch, and I did it so as to ensure, as I hoped, aseptic purity without contact of any antiseptic material with the wound. For this purpose the sponges, purified as usual by being kept in 1 to 20 solution, had the carbolic acid removed by washing in water that had been boiled, and other things were similarly treated. At 10 a.m. a kettle having been brought fully to the boil in the kitchen, was taken upstairs and left to cool. . . . The patient's shoulder having been washed with 1 to 20 carbolic acid solution, and my hands and those of John Godlee having been purified with the same, our coats being off, we dipped our hands in boiled water and then I proceeded to operate with the clean but not antiseptic instruments and sponges. Chloroform was not given. A single incision in the course of the line from the nape of the neck to the shoulder, exposed the growth which, being non-adherent, was squeezed out of its bed without any difficulty; a single vessel was twisted, the edges of the wound were brought together by three stitches of the aseptic silk at intervals of about ¾ inch, the edges lying nicely in apposition though the wound was not occluded."

There was no drainage tube. The dressing was a piece of moist aseptic gauze eight layers thick, covered by a substantial piece of dry salicylic cotton-wool. After five days the dressing was removed and it does not surprise us now to learn that the wound healed by first intention, though with his usual accuracy and honesty he described minute rosy areas round each stitch and one of the same size at the upper end of the wound, all of which had disappeared at the time of the second dressing five days later.

[1] *Collected Papers*, vol. ii. p. 369.

It is not denied that much more care and trouble are required to obtain uniformly good results by modern methods than by those which Lister recommended. Not only because the surgeon himself must be more watchful, but because he must attempt the impossible task of keeping an eye on his assistants and nurses whether in sight or behind the scenes. For the safety of the patient these should be few and fully trained, whereas they are many, including in hospital practice half-trained dressers and probationers. One weak link may cause the chain to snap, but unfortunately the fact that it has given way is not suspected till a disaster has followed. The chain has too many links for security—not only the theatre staff but the army of private nurses, and the tradesman's operatives who carry out a routine the true meaning of which, however skilled they may be, they cannot thoroughly understand. Mistakes are so easy to commit: for example, the handling of a pure swab with an unpurified hand, or covering a vessel of boiled water with an unsterilized towel. An observant bystander sees such things happening, and fears for the result because there is no guard at the entrance of the fortress: that is, no trustworthy antiseptic protecting the immediate vicinity of the wound.

And what are the results? There is no justification for sweeping statements on one side or the other. If I am prejudiced—and who is not?—it is in favour of the Listerian methods. Those who share these views allow that abdominal surgery has greatly benefited by the introduction of the aseptic technique. But they say that in other fields of surgery this has been followed, not so much by disastrous results, as by a lowering of the standard at which a conscientious surgeon aims. They say there is not the same uniformity, or the same proportion, of complete success; that whereas Lister and his immediate followers looked upon suppuration as a disgrace if the skin was unbroken before the operation was begun, it is now not uncommon for a certain amount of pus to be seen, and that if this occurs it gives rise to no searchings of heart, no enquiry is made as to its possible cause, and it is passed over as an un-

avoidable accident with the observation that " the case has gone wrong."

They do not maintain that such occurrences are only due to flaws in the aseptic technique, but they point to one radical defect which appears to encourage suppuration. After an operation, in spite of every precaution, cocci, not always innocuous cocci, reach the surface before long from the deeper parts of the skin. An antiseptic dressing destroys them or, at least, inhibits their growth; a piece of plain sterile gauze has no such effect. Under the latter therefore they can grow and multiply, and make their way into the stitch tracks where the tissues have been slightly damaged by the passage of the needles, and by tension if the stitches are tight. Then what are called " stitch abscesses " may occur. They are now apparently not uncommon, if we may judge by the casual way in which they are spoken of. Lister used to say that he never had them; but it is only fair to add that few of his most faithful followers can boast of being so uniformly successful in avoiding them; and also that secondary infection from the skin is probably not the only cause of such abscesses, though it is the principal one. Now a stitch abscess is not such a trivial affair as it is sometimes made out to be. The suppuration may extend to the deeper parts of the wound, where deep stitches intended to be permanent—" buried stitches "—have been placed. Then these deep stitches act as foreign bodies and have to make their way to the surface, or to be removed, before the wound can heal. Many an operation performed with the utmost skill has failed as the result of a stitch abscess. Let it not therefore be thought that too much is being made of a small surgical detail. It is really a matter of great importance. If what has been said is true, and if this were all that could be urged against the aseptic method, it is enough to justify the assertion that it will be a good day for surgery when a return is made to pure Listerian methods, when someone rediscovers what Lister taught, and preaches again the doctrine which Lister preached.

During the early stages of the present war the orthodox antiseptic and aseptic methods failed to prevent or control

the septic infection of wounds, and all the modifications of Lister's methods that were tried gave no better results.

Sir Almroth Wright then brought forward his "hypertonic treatment," which consisted in the constant application to the wound of salt-solution of such a strength as was calculated to encourage to the utmost the flow of lymph from its surface. He trusted to the bactericidal powers of the lymph and to the injection of an appropriate vaccine or serum to overcome the organisms which, he stated, it was impossible to destroy by any chemical antiseptic in such wounds as are inflicted in modern warfare. Wright's treatment was thus founded on the same principles as those on which aseptic surgery rests.

For a time it met with great favour in our army, though, from the first, doubts were expressed as to its efficiency; but already less is heard of it; indeed, it is said that it has been to a large extent superseded by a true antiseptic method introduced by Dr. Carrel, who is working at the Research Hospital at Compiègne.

Carrel claims to have solved the problem of the disinfection of wounds, whether the infection be acute or chronic, by means of a chemical antiseptic; and he calls this treatment *une méthode chimiothérapique.*[1]

He lays stress on the following points:

1. The choice of a suitable antiseptic. In the search for such a substance he was helped by Dr. Henry D. Dakin, who, after testing a great many, fixed upon a solution of hypochlorite of sodium, polyborate of sodium, and small quantities of free hypochlorous and boric acids.

2. The gentle but thorough mechanical preparation of the wound: that is, the opening up of all diverticula, the removal of foreign bodies, blood-clots and damaged tissue, and the complete arrest of bleeding.

3. The introduction of the antiseptic fluid, either by constant irrigation, or at intervals of not more than two hours, through fine indiarubber tubes permanently fixed in all the recesses of the wound.

[1] *Le traitement des plaies infectées*, par A. Carrel et G. Dehilly. Masson et Cie. 1917. English translation by Herbert Child, Captain R.A.M.C. (T^{y}). London: Ballière, Tindall, and Cox. 1917.

4. The daily bacteriological examination of the discharges; and the closure of the wound when the number of micro-organisms has been reduced below a number which experience has shown will not interfere with the occurrence of primary union.

Carrel's treatment would have delighted Lister. It is an extension of his own system to infected wounds, such as he only attempted, or only succeeded in carrying out, in a limited number of cases, principally those of operations through parts that were the seat of chronic suppuration.

If the results obtained by Carrel in a small highly organized research hospital can be obtained in large war hospitals, a new era will have dawned for military surgery. But there are obvious drawbacks and limitations; not the least is that, as he points out, a special training is required even for experienced surgeons, and that failure to carry out all the details is sure to lead to disappointment. The amount of care and trouble, and the enormous number of microscopical examinations that are involved, cannot be overlooked. Carrel hopes all this may be simplified; he does not claim to have reached finality, but he appeals for a fair trial of his treatment with all its complications, on account of the very striking results which he himself has undoubtedly obtained.

CHAPTER XXVIII

LIFE IN LONDON. BARONETCY. MEDICAL SOCIETIES. THE ROYAL COLLEGE OF SURGEONS

(1880-1888)

For fifteen years Lister occupied the chair of clinical surgery at King's College. He soon fell into the usual habits of the London consulting surgeon, with early private operations, morning consultations at home, afternoon hospital visits, and occasional attendance at Societies' meetings in the evening. The medical circle is large and hospitable. Private and public entertainments become a burden to a busy man, but they were claims from which Lister could not escape. As a new comer he probably had a wider dining acquaintance amongst the leaders of the profession than is usually the lot of one who has grown up amongst them and has reached the age when, as has been satirically said, the successful doctor buys pictures and gives dinners. Thus he was on terms of friendly intimacy with most of the best known representatives of medicine of the day—Jenner, Gull, Paget, Erichsen, Andrew Clark, Broadbent, Thomas Smith and many others. But the time of life for making real friendships was past. Probably he was in closest sympathy with his two colleagues Sir William Bowman and Dr. George Johnson, who had been chiefly instrumental in securing him for King's College. None of these, however, were so near to him as his old fellow-student Sir William Roberts, who migrated from Manchester in 1889, and Matthews Duncan, who was translated from Edinburgh to St. Bartholomew's in 1877. His connection with the Royal Society, on the Council of which he served 1880-1883, brought him into a

large scientific circle. But his own family used to complain, and he joined in the complaint, that they saw less of one another when living a few miles apart, than when separated by the length of England.

Lister had been Surgeon-in-ordinary to the Queen in Scotland since 1870, having succeeded Syme in that office. Soon after he came to England, in October 1878, he was appointed Surgeon-in-ordinary to Her Majesty, on the death of Mr. John Hilton.

In the year 1880 he received the LL.D. Cantab. and the D.C.L. Oxon., the latter with Fawcett, Millais and Watts. Foreign distinctions were bestowed in abundance; but it was not till 1883 that he was made a baronet. To many it seemed that this honour had been long delayed, and it was whispered that it had been offered and refused, and also that it had not been offered because his views on vivisection were not approved in high places. Both these rumours were without foundation. It had long been a cause of complaint that baronetcies were seldom bestowed on medical men. Sir Thomas Watson's death in December 1882 reduced the number to four, only one of whom was a surgeon. The distinction was therefore greater than it is at the present day. The Crown now made up for lost time by giving four other baronetcies in 1883, to Bowman, Andrew Clark, Prescott Hewitt and Spencer Wells.

Lister was in theory rather opposed to such rewards for scientific distinction, and had been in the habit of speaking of "plain John Hunter" as of one whose reputation was a sufficient honour and reward. He was chiefly impressed with the danger of men of science entering into an undignified strife for titles. Some reference to this is made in a congratulatory letter from his friend Dr. Gairdner of Glasgow, who himself was not long afterwards admitted to the order.

"GLASGOW UNIVERSITY, Feb. 9, 84.

MY DEAR LISTER,

I believe I only did not write to you on the announcement of your baronetcy, because I had a strong feeling that your own mind would rather be against empty congratulations in respect of the mere titular appendage, while you have the secure confidence that all your friends, and I not least so, are very ready to do you honour

and to sympathise with all that is said and done in that way by others. I cannot refrain, however, from noticing what is to me much more than the baronetcy—the graceful and modest, and at the same time, proud and self-reliant words you uttered at Manchester.

The *race* after honours and dignities, if it is heedlessly indulged, will prove the ruin of our profession, and therefore I thank you from my heart for words which are the echo of my own thoughts, often expressed to those most in my confidence. I do most heartily wish you may long enjoy your honours, but you can never be more to me as Sir Joseph, than you were as Joseph Lister.

I am, Yours very truly,

W. T. GAIRDNER."

The two most interesting foreign distinctions of this period were the award of the Boudet prize (1881) of 6000 francs for "his application of M. Pasteur's researches to the art of healing," and the Prussian Ordre pour le Mérite (1885) which was then a great honour, being restricted to 30 Germans and 30 foreigners, and, at that time, included no other medical man actually engaged on practice.

On the whole, Lister's life was less strenuous in London than it had been in Edinburgh. Neither public nor private engagements were so exacting. But there was no relaxation of experimental work. The sanctum contained still larger hot boxes, and even more retorts, beakers, and chemical and physical apparatus than in Edinburgh. It was his constant resort at odd moments during the day, and long hours of the evening and night. The "common place books" are as full as ever of notes of elaborate observations concerned chiefly with perfecting the catgut, and testing the germicidal powers of different reagents in the course of the perplexing researches which resulted in the production of the double cyanide gauze. There are many others. A long series was carried out in 1878 on hydraulics, bearing upon the question of the relative pressure in arteries and veins. Another series was undertaken in 1882 to test Paul Bert's theories with regard to the effects of chloroform. But after the 1881 Congress he did not work much at the life history of bacteria, or rather he worked vicariously, as this line of investigation fell more and more into the hands of those

who were directing all their energies to the attractive study of bacteriology. As this had the charm of novelty and offered an apparently boundless field for discovery, pure bacteriologists were plentiful, some of whom were intending to devote their lives to the pursuit, and others to make it a stepping stone to medical or surgical appointments.

Bacteriological problems now became the burning questions for discussion in the medical journals, and the references to antiseptics, which were few and far between, dealt chiefly with the subjects which were occupying Lister in his study—the search for new dressings or the discovery of imperfections in the old. Occasionally discussions arose as to the applicability of the treatment to special branches of medicine such as ophthalmology or midwifery; but the main principle was by this time generally taken for granted. It is true that opposition to the whole system flared up from time to time, as in the writings of two well-known gynaecologists, Lawson Tait[1] and Bantock. But such effusions became rarer, and before long were heard no more. They were indeed gradually merged in the milder opposition of the advocates of aseptic surgery.

The fact is, that Londoners had become accustomed to Lister's presence amongst them, had discovered that he was a true man, and had adopted him as one of themselves. The rising generation of surgeons, for the most part convinced followers, were securing the junior and even a few of the senior appointments at the great hospitals. Some of the latter were approaching middle age. Such men are always found upon the staffs of the journals; and editors, if they are wise, do not shut their ears to what they say; for they are better judges of new ideas than ardent juniors to whom every novelty is a portent, or grave seniors who view each innovation with suspicion.

Lister's very pertinacity also wore down opposition. His frequent modifications of detail convinced thoughtful people

[1] "The Antiseptic Theory tested by the Statistics of One Hundred Cases of Successful Ovariotomy," *Medico-Chirurg. Trans.* 1880, vol. lxiii. p. 161; "Recent Advances in Abdominal Surgery," *Trans. Internat. Med. Congress*, London, 1881, vol. ii. p. 228.

at least that it was not the details but the principle which mattered. Thus the frequent changes which at first proved stumbling-blocks were now counted to him for righteousness. If we recall the severe sayings of the *Lancet* in previous years, we rub our eyes on reading these words of wisdom in a leader commenting on the introduction of the cyanide dressing in 1890. After praising "the persistence with which Sir Joseph Lister endeavours to perfect the practical details of the great aseptic method of treatment which has revolutionized modern surgery," it continues:

"To the unthinking it may seem strange that a 'new' antiseptic dressing is so often introduced to the profession, even by the founder of the system himself. But, in truth, no better evidence of the substantial soundness of the principle upon which the system rests could be adduced, and the scientific character of the aseptic system is broadly attested by the constant perfection of the details, and by its almost daily development."[1]

But, indeed, these words of the *Lancet* need cause no surprise, for the whole of the medical press had by this time become completely sympathetic; and not the press only, but the majority of his professional brethren. So that it began to seem natural that he should play a leading part in public matters, such as medical education, or the admission of women to medicine, a proposal to which he was always strongly opposed. Thus in 1888 when one of the medical journals[2] committed the indiscretion of publishing some details about the illness of the Emperor Frederick, which violated professional secrecy, it was at Lister's house that an influential meeting was held to urge that an apology should be tendered to von Bergmann, whose name had been mentioned in an altogether unjustifiable way.

In London, men from all the schools meet on common ground at the Medical Societies. Here acquaintances and friendships are formed; and reputations made or lost. These societies were more numerous and more active at the time of which we are speaking than to-day, for many of them

[1] *Lancet*, 1890, vol. i. p. 89.

[2] *Brit. Med. Journ.* 1888, vol. ii. pp. 1244 and 1472.

have been amalgamated in the Royal Society of Medicine, and have thus lost all sense of rivalry and something of their individuality. Older men who have won their laurels and cling more closely to the domestic hearth seldom attend the meetings regularly, and Lister was no exception to the rule; but he contributed to them a number of important papers.

The first of these, on the lactic fermentation,[1] was read before the Pathological Society in 1878. In 1879 his address on the effects of the position of a part on the circulation through it, was given to the Harveian Society.[2] He was most intimately associated with the Clinical Society, of which he was President—and a very active President—for the years 1881 and 1882. His presidential address was on the catgut ligature.[3] Before this he had communicated to the Society, in conjunction with his colleague Dr. Burney Yeo, a short paper[4] which is full of interest and affords a characteristic illustration of the way in which he applied his old physiological observations to his later surgical work. It described a patient at King's College Hospital who had stertorous breathing, supposed to be due to a large aneurism which was actually present in the chest. On careful inspection of the throat the stertor was found to be caused by a warty growth in the larynx as large as a small chestnut. The growth, together with the whole of both vocal cords, was removed by a then novel operation. After recovering from the operation the patient was shown at this meeting of the Society, and surprised the audience by speaking so loudly that he could be heard all over the room, and coughing in a normal manner, although he had been deprived of his vocal cords.

This gave Lister the opportunity of recalling his old observations on laryngeal stertor, that is, stertor caused by obstruction in the larynx as distinguished from that originating in other parts of the air passages, such as the nose or the windpipe. They were recorded in his article on anaesthetics;[5] "but," as he said, "a work on practical surgery being not

[1] See page 422. [2] See page 428. [3] See page 238.
[4] *Trans. Clin. Soc. Lond.* 1878, vol. xi. p. 104. [5] See page 103.

a likely quarter for information regarding the physiology of the larynx it is not remarkable that they should have attracted little attention."

These observations were begun when he was Syme's house surgeon. He noticed that the dangerous stertor caused by an overdose of chloroform was relieved by pulling the tongue out very forcibly, whereas a gentle pull failed to produce this effect. He told how afterwards when he was preparing the article on anaesthetics he tried to find out something more about this curious phenomenon and resorted to an experiment on one of the lower animals.

"Having put a sheep under chloroform, in a slaughter house in Glasgow, I made an incision into the pharynx, with a view of inspecting the larynx. But, having done so, I saw an appearance which filled me with amazement. Instead of having the chordae vocales exposed to view, as I expected, I saw only a pair of red valves, moving indeed in accordance with the panting respirations of the creature, as I held the towel with the chloroform before the wound, but with such rapidity as entirely to prevent me from seeing the *rima glottidis* [the space between the vocal cords] beneath. I had just got so far with my observations, when the inspector of the slaughter house walked up and told me he would not allow such brutality in the institution over which he presided and forthwith ordered me off the premises. Thus I had a taste of what has been since, alas! experienced so largely by our profession in this country, viz. how ignorant prejudice, with good intentions, may obstruct legitimate scientific enquiry."

Those were the early days of laryngoscopy. Garcia, the great teacher of singing, made the first laryngoscope in 1854, for studying his own vocal apparatus, but the instrument only became practically useful when modified by Türck and Czermak in 1857. By 1861 Lister was examining his own throat with it to try to clear up the question of stertor under chloroform narcosis. It is too technical for these pages, but it is one that cannot be passed over without notice, because it was a favourite subject with him, and one of those in which he thought that his early observations had failed to make a permanent impression. He then convinced himself that the dangerous stertor of chloroform was produced by the approximation of those red folds of mucous membrane he

had seen in the throat of the sheep (the aryteno-epiglottidean folds, as they are called); he now stated his belief that by means of them the explosive act of coughing was caused, and the deep monotonous voice of this particular patient was produced. He also held that these folds might be, and actually were, used voluntarily for voice production under some circumstances. "If I may do so without offence," he said, "I will produce a voice of this kind before you. I now speak with my aryteno-epiglottidean folds. And since I knew from our patient the possibility of this kind of voice, I have noticed its employment sometimes in ordinary parlance, as in the sentence 'Get away with you,' which I heard uttered by one little boy to another in the street not long since in a voice far too gruff to have been produced at his age by the chordae vocales."

Modern text books of physiology do not mention these views concerning voice-production and coughing; but there is no doubt that this particular patient could speak loudly and cough with remarkable efficiency. Lister had not, however, proved his point, because he overlooked, what subsequent observations have shown to be the case, that Nature can fashion extraordinarily useful vocal cords out of scar tissue. Many laryngologists now say that coughing under normal conditions is brought about neither by closing the vocal cords as most physiologists would have us believe, nor, as Lister held, by approximating the aryteno-epiglottidean folds, but by means of another structure lying between the two, known as the false vocal cords. At the time the paper was written the matter was little thought of and very imperfectly understood. It is fair to say that we are still waiting for an authoritative and convincing account of this rudimentary physiological process.

The Hunterian, one of the less ambitious of the London Medical Societies, held its meetings in the City. In 1889 Lister contributed to it one of his numerous papers on the cyanide dressing.[1]

[1] See page 300; *Lancet*, 1890, vol. i. p. 1; *Brit. Med. Journ.* 1891, vol. i. p. 1057; *Collected Papers*, vol. ii. p. 324.

The Medical Society, the doyen of the group, founded by Fothergill and Lettsom in 1773, seems to have had a particular attraction for him, as was shown by his bequest to them of the pick of his medical library. He delivered the annual oration on no less than four occasions. One dealt with the coagulation of the blood;[1] two with antiseptic dressings;[2] and the fourth was on the burning question of the "open treatment" of fracture of the patella,[3] that is, operating on a broken kneecap instead of treating it with splints. This was in 1883, at which time he was, as we have said, working less and less at the bacteriological foundation of the antiseptic system, and devoting more attention to showing how the fields of surgical usefulness might be extended by the protection from danger which the antiseptic treatment afforded.

The treatment of fracture of the patella had always hitherto been unsatisfactory. Bony union between the fragments was rarely obtained. In the course of time the two portions of the broken bone often became widely separated owing to the contraction of the strong muscles of the front of the thigh. Consequently, the complete utility of the limb was hardly ever restored, while, in the large majority of cases, great weakness and often considerable lameness resulted.

In pre-antiseptic days no one would have dreamed of cutting down on the fracture and fastening the two fragments together, because to do this involves the opening of the knee-joint. But this was Lister's proposal and had for some years been his practice, which, together with that of cutting down upon, resetting, and wiring badly united fractures of the long bones, was the forerunner of the highly elaborated bone and joint surgery of the present day.

Before 1873 Lister had often said to Hector Cameron that he thought the use of the silver suture, antiseptically applied, should be extended to fractures of the patella and also to

[1] *Brit. Med. Journ.* 1884, vol. ii. p. 803; *Collected Papers*, vol. i. p. 189.

[2] *Lancet*, 1889, vol. ii. p. 943; *Collected Papers*, vol. ii. pp. 293 and 309.

[3] *Brit. Med. Journ.* 1883, vol. ii. p. 855; *Collected Papers*, vol. ii. p. 453.

those of the olecranon (the bony point of the elbow). The first suitable case, a man with a fractured olecranon, happened to come to Cameron, who, as he had no beds at the time in the Glasgow Infirmary, brought the patient to Edinburgh, where he was successfully operated upon by Lister. In this, as in all the early cases, the wire was removed when union was sound. The man obtained a perfectly useful elbow, and wielded the hammer in an iron shipbuilding yard with his former energy.

Lister had two other equally good cases of fractured olecranon. One of these patients had consulted eighteen surgeons before coming to him. Now, for the first time, he cut short the ends of the wire which, after the knot had been hammered down flat, was left permanently *in situ*. This caused no inconvenience and had the advantage of allowing the patient to use his limb much sooner than if the wire had been removed.

It is difficult to understand, seeing how common the accident is now, why Lister was for four years on the look out for a suitable case of fractured patella to treat in the same way. After all, he was anticipated by Cameron, then full surgeon to the Glasgow Infirmary, who was the first to perform this operation, in March 1877. It was successful, in as much as the healing took place without inflammation and a thoroughly useful limb resulted; but bony union was not obtained.

Lister's first case was at King's College Hospital in October 1877, and by the time his paper was read, in October 1883, he was able to report that he had operated on seven cases, some of recent, and some of old ununited, fractures. All had been completely successful. Six of them were shown at the meeting.

The steps of the operation were described in great detail, and certain new anatomical points were brought forward which had been disclosed by this method of operating, and which explained the common failure to obtain bony union by splint treatment.

Some general remarks at the end of the paper must be quoted, because they define his position with regard to the

security afforded by the antiseptic treatment at that time, and give a grave warning of the risks involved by pretending to carry it out in a careless or unconscientious manner.

He had been saying that "considering the great inconvenience which results in many cases when the treatment is conducted on ordinary principles," he believed that "if we could say that we were morally certain that we did not subject the patient to a risk, we were in duty bound to give him the benefit of this method." He had also referred to the danger of an inquisitive patient lifting up the dressing to look at his wound, and he concluded with the following passage:

"I had a gentleman lately under my care with a psoas abscess; he was very intelligent, and seemed duly impressed with the importance of the antiseptic management; and yet his brother, who was a medical man, coming in one day, saw him drawing the dressing aside, and peeping at the wound. Now a man cannot peep at a wound in connection with a fracture of the patella; it is so circumstanced mechanically that he cannot do it; and I believe that if we use the means that we have now at our disposal, we may say, with a safe conscience, if we use them aright, that we do not subject the patient to risk, not to anything like so great a risk as patients used to be subjected to not many years ago when they had fatty tumours removed in general hospitals in London. We must all of us remember cases in which, after such operations, erysipelas or diffuse suppuration came on, or some other 'unhealthy action,' which, of course, was nobody's fault, but the patient died.

I have referred to a case of ununited fracture of the olecranon where eighteen surgeons had been previously consulted. I trust no one here will suppose that I mentioned this circumstance for the purpose of glorifying myself. I mentioned it in order to emphasize what I believe to be the truth, that by antiseptic means we can do, and are bound to do, operations of the greatest importance for our patients' advantage, which, without strict antiseptic means, the best surgeon would not be justified in recommending. How wise those eighteen gentlemen were in counselling against operative interference, provided they were not prepared to operate strictly antiseptically, I think we must be all agreed. As regards the operative procedure in that case, it was of the most simple character; any first year's student could have done the operation exactly as well as myself; and, therefore, I trust I shall not be misunderstood by its being supposed that I came here to extol my own skill. That which justified me in operating in that case was simply the knowledge that strict antiseptic treatment would convert serious risk into complete safety.

I should have liked, if time had permitted, to have said a few words as to what seem to be the essential points as regards antiseptic treatment. If I say any words at all now, they will be exceedingly few. I should just like to make this remark, however, that nowadays antiseptic treatment is not a very complicated business, either in theory or in practice. First, as to theory, we do not require any scientific theory to enable us to believe in antiseptic treatment. You need not believe in the germ theory at all; if you are not convinced of the truth of the germ theory of putrefaction and of septic agencies generally, no matter whatsoever with reference to antiseptic practice. All that you have to believe is that there are such things as putrefaction and other septic agencies, and that our wounds are liable to these, and that they are very pernicious, and that these things come from without, and that we have the means of preventing them by various chemical agencies. That is all that we require; and I think anybody who knows the present state of surgical practice must admit these to be truisms. It has sometimes been a great grief to me to think that, because gentlemen are not convinced of the truth of the germ theory out and out, therefore they lay aside antiseptic treatment altogether. And then as to practice; it is not a very difficult thing to wash your hands in a carbolic solution, and have your instruments in this carbolic solution for a quarter of an hour before you operate. It is not a very difficult thing to wrap round the limb a suitable envelope of antiseptic material. What I believe to be one of the most important things of all is, strictly to maintain this rule inviolate, which I insist upon with my dressers, and which I confess I have insisted upon more of late years than I used, and that is, always when we change a dressing, invariably first to cover the wound with something pure; not to wash the surrounding parts with antiseptic solution, and then, after this has been done, put a dressing on the wound; but before we begin to defile the lotion at all, put on the wound what is pure, and last thing of all, wash the surrounding parts, which, though they look the same to our eyes, are different *toto coelo*. The edges of the dressing are septic; the wound, if it is as it ought to be, is aseptic. I have known such a thing, for instance, as for a gentleman, in dressing a stump after amputation of the thigh, to wash the perineum with a rag dipped in the carbolic lotion one in forty; and then, having so washed the perineum, immediately to squeeze the rag over the wound. Gentlemen, that makes you laugh; but I assure you these are the kind of things that are constantly going on, and disasters happen in consequence; and gentlemen with whom things go wrong invariably say that with them everything has been perfectly done—a thing which, for my part, I am always loath to say. I am not likely to have many more years of active surgical work; and I

have felt that when you, Sir, gave me this opportunity, it was my duty to speak what I believe to be the truth; for I feel it to be a grievous thing that patients should be hurried out of their lives, or deprived of usefulness of limbs, simply for want of sufficient earnestness with regard to the endeavour to obtain complete exclusion of septic agencies from wounds, according to our present lights and our present knowledge.

Gentlemen, I thank you most heartily for your cheers; for there was a time when such remarks might have met with a different reception."

This reference was to the early fierce criticism recorded in previous chapters. But even in 1883, such statements did not pass unchallenged. A second evening was occupied by a lively discussion of the paper. Surgeons came forward who maintained that the old treatment was not so unsatisfactory after all; but it was easy to show that they were satisfied with indifferent results. The real interest of the debate, however, centred on the concluding passages just quoted. One member hinted at disasters which had occurred in the practice of others, concerning which, it will be remembered, Lister also had spoken and given a most solemn warning. He went on to say that he could not understand Lister's statement that "serious risk" could be changed into "absolute safety"; that the use of such terms instilled over-confidence in his juniors and disciples; and in short, that he could not believe that Lister meant what he said. Another speaker asked him whether, if he broke his own patella, he would have it wired by another surgeon, and after professing to believe in the antiseptic system, concluded that this particular application of it was "magnifique mais ce n'est pas la chirurgie"—an observation long remembered against him. But the seniors and the conservatives did not have it all their own way. Lister's supporters were lively, and they were strong, and he himself made good use of his right of reply in defending his position and driving home the points he insisted upon.

One other meeting, that of the Woolwich Military Medical Society, held on February 15th, 1884,[1] must not pass unnoticed.

[1] See *Lancet*, 1884, vol. i. p. 345.

Lister and several other civil surgeons were invited to take part in a debate on a paper read the week before, by Surgeon Major Godwin, on the application of antiseptic surgery to field service. Demonstrations of antiseptic dressings likely to be useful in war were given, but no one present had any fresh experience gained since 1870 to bring forward, except Sir William MacCormac, who, in the war of 1876 between Servia and Turkey had visited both camps, where nothing bearing upon the subject under discussion was to be learned.

Lister spoke hopefully, justifying his hopes by Karl Reyher's brilliant results in the Russo-Turkish War.[1] He suggested simplifications, such as giving up the spray and employing corrosive sublimate in preference to carbolic acid on account of its greater portability. He also advocated the use of iodoform and of iodoform mixed with boracic acid. But his speech was not of great importance. A very flattering article followed in the *Lancet*, which spoke of its being no longer a question whether antiseptics should be used in war, but a question of the best manner of employing them.

The occasion was noteworthy as indicating a drawing together of military and civil surgeons, which since that time has become much more close, to the great advantage of the service and of the profession generally.

All this work for the Medical Societies did much to make Lister's face and voice familiar to his fellow-citizens. And the circle became still wider in July 1880, when he was elected a member of the Council of the Royal College of Surgeons. A close bond of intimacy exists between the twenty-four men who form this body, meeting as they do regularly once a month, and between times on countless committees.

He did not apparently find the routine work much to his taste, and it is said that he took little part in ordinary College business. This was not the case, however, when matters of more general interest to the profession came under discussion.

During the early part of 1880 the failure of the scheme for a conjoint examination in each division of the United Kingdom —the "one portal" or "one board" system mentioned in a

[1] See page 350.

previous chapter[1]—was announced. In the meantime the College of Surgeons had so far set its house in order that it had instituted an examination in medicine in addition to the ordinary examination in surgery. This, it must be owned, was not alarming from its severity, but the taunt could no longer be made that a member of the College of Surgeons might have his name placed upon the Medical Register on the strength of a surgical qualification only. Lister now strongly supported the attempt to arrange for a conjoint examination with the Royal College of Physicians. For the time being this attempt was unsuccessful. The College of Surgeons accordingly added an examination in midwifery to its curriculum, thus rendering its diploma a qualification in the three recognized branches of practice. The desired association of the two Royal Colleges was brought about in 1884. It has saved both students and teachers much time and labour, and has been of real benefit to the public. It has also had the advantage of drawing the two ancient corporations into much closer sympathy than existed before. The examinations of what was now called the "Conjoint Board" were complete and satisfactory, so much so that when in 1886 the Society of Apothecaries asked to be allowed to participate in the scheme, and their appeal was strongly backed by the General Medical Council, Lister actively opposed the proposal. He thought the combination for examination purposes unnecessary and for various reasons undesirable.

The control of the Conjoint Board is entrusted to a small but highly responsible "Committee of Management" appointed by the two Colleges. Lister became a member of this committee in 1886, and there is an amusing tradition that the rule that business stands adjourned at 10.30 p.m. originated in the extremely lengthy discussions between him and his argumentative colleague Sir William Savory on the respective merits of the English and Scottish systems of examination.

In 1880, the year of Lister's election, an old standing grievance of London students occupied the attention of the Council. The title of Doctor could not be obtained in the metropolis of the Empire without submission to the extraordinarily rigid,

[1] See page 403.

indeed almost prohibitive, test of the University of London. Those who, for any cause, could not face this ordeal, were obliged either to go without a degree, or to spend time and money on excursions to Durham, Brussels, or Paris, or certain other foreign Universities where degrees could be obtained on easy terms. It was a just cause of complaint, that, while London students were practically debarred from obtaining the coveted title, which had a real money value, any Scottish or Irish student of average ability could easily obtain an M.D. degree by passing an examination certainly not more severe than that for the diploma of the two Royal Colleges. Scottish and Irish invaders were thus, it was maintained, competing with English doctors on unequal terms. In the eye of the public an M.D. was a "proper doctor," which a diplomate of the Colleges was not; and unfortunately hospital and other public boards were scarcely more discriminating. In view of this grievance the Council of the College of Surgeons discussed the question whether it was desirable that degrees should be given by the two Colleges in combination, and, if so, under what conditions.

The matter did not concern the students only. The teachers feared that they also would suffer by still further contraction of their sphere of usefulness, and diminution of their fees. Already English students, attracted by cheap living and easily obtainable degrees, were flocking to Scotland, where they crowded the wards to an uncomfortable extent, rendering both teaching and learning equally difficult. And new English Universities were now springing up almost year by year. London teachers watched this movement with alarm, and in their gloomier moments foresaw Universities planted in all the provincial towns, competing with one another for students by lowering the standard of their degrees, and bleeding to death the ancient schools of London, with their antiquated notions but unrivalled opportunities. Vigorous efforts to prevent this catastrophe were therefore made by the medical advocates of a teaching University for London, which it was fondly hoped would offer a medical degree upon easier terms. One of these numerous agitations for a teaching University was in full swing at the time, and

naturally roused the strongest opposition to the scheme of the Colleges, which accordingly before long was dropped.

The whole subject bristles with difficulties. Probably, if it had not been for the extreme severity of the London degree, the prohibition of the College of Physicians to its licentiates to use the title of Doctor, and the recognized grievance of the London students, few, if any, would have advocated the formation of what would have been, in fact, a very limited, unacademic, one-faculty University. Lister, however, was, for a time, in favour of it. But he changed his mind. In his evidence before the University of London Royal Commission of 1889 he said :

" As a member of the Council of the College of Surgeons I favoured at first the idea of those two Colleges giving a degree or degrees in medicine. . . . But finally the idea has been entirely given up as apparently perfectly hopeless; and I confess, such being the case, that my sympathy with the movement in favour of the two medical colleges giving the degrees is entirely gone. It seems to me that it would be a degradation of the degree to give it on the minimum possible of professional qualification." [1]

The College of Surgeons is the lineal descendant of an old City Corporation. Its governing body, though modified by many charters, still shows traces of its origin. Its 18,000 Members, who have gained this title simply by passing the necessary examinations, are scattered all over the world and for the most part know little, and care less, about medical politics. A compact body of them are, however, in a chronic state of discontent, and once a year at least attack the Council in no measured terms, asserting that the Members have an inherent right to a voice in its election and to a certain number of seats at the Council table. They also accuse this body of being an effete oligarchy, disposing of the large funds of the College in an improvident, useless and indeed shameless manner. These matters were of no interest to Lister except that they excited his impatience and made him grudge the time necessarily devoted by the Council to their consideration. To this statement one exception must be made. The election of the Council is entrusted by charter to the Fellows, a select

[1] *London University Royal Commission*, 1889, p. 46, Q. 487, 489.

body of some 1,300 who have, so to speak, risen from the ranks of the Members by passing a very severe examination, and are for the most part devoting themselves to the practice of pure surgery. They are thus well informed on surgical matters and form a manageable constituency. Amongst the Fellows there existed an "Association" consisting of reformers who also desired some changes in the electoral system, and applied to the Government of the day for a supplementary charter. One of their proposals was that the President should be elected by the whole body of the Fellows instead of, as was then, and is still, the custom, by the Council. Lister held very strongly that the position of President would gain much in dignity if the appointment were made by all the Fellows, and he proposed that the request of the Association should be granted, provided that their choice should be limited to those Members of Council who had already held the office of Vice-President. The proposal met with scanty support. He perhaps did not take sufficiently into account that the Fellows have no share in the actual government of the College, and that such a plan as he proposed might have led to unseemly canvassing, and the selection of men distinguished more for their professional standing and general popularity than for their knowledge of the affairs of the great institution over which they would be called to preside.

In 1887 Lister gave the "Bradshaw lecture," an annual oration at the College in memory of a Reading doctor of that name. Of this lecture only the title is preserved, and the recollection that he arrived ten minutes late on the occasion of its delivery. The subject was "The Present Position of Antiseptic Treatment in Surgery." It does not appear to have been reported even in abstract, and no record of it is found amongst his papers.

On the whole, then, it may be said that he took no very active part in the affairs of the College.

After eight years' service, members of the Council have to seek re-election if they wish to retain their seats. If returned a second time, they may in due course be chosen as President. The Presidency is no sinecure, and thus, while some look forward to it as a prize, others dread it as a penalty.

Lister had become completely identified with London; all personal opposition to him had disappeared; and it was generally recognized that, if he were re-elected, the Presidency would certainly be offered to him. The thought of this distressed him, partly, perhaps chiefly, because he considered himself unfitted for the office. He therefore pondered long over the question whether it would be shirking a public duty to refuse it. At last he decided not to come forward, in spite of the advice of such friends as Sir James Paget, who wrote:

"1 HAREWOOD PLACE,
June 7, 1888.

MY DEAR SIR JOSEPH,

I thank you for your kind letter and am very sorry,—most of all for the chief reason which you feel inducing you to resign. Let me suggest only one thing more, that you might remain on the Council but let it be understood that you do not wish to be President. You would thus, with but little addition to your work, do the College great good: for it never more than now needed men who would promote its scientific work.

I will only ask you to think of this: you need not write an answer; I will only hope to see a change.

Always sincerely yours,
JAMES PAGET."

His decision was reached, not so much because he knew that the presidential duties would be uncongenial, as because he was becoming more and more impressed with the shortness of life, and with the knowledge that, at the age of sixty, the time was necessarily limited for completing the mass of scientific work he ardently desired to accomplish. The following year he became much occupied with the affairs of another institution, an account of which will be given in the following chapter.

CHAPTER XXIX

THE LISTER INSTITUTE

THERE is a large red building designed by Alfred Waterhouse on the Chelsea Embankment, now known as the "Lister Institute of Preventive Medicine"; where research into infective diseases is carried out, and whence are distributed sera and vaccines, now so extensively used in the treatment of these affections. The history of the Institute is not easy to trace; it has had a varied, it might almost be said a chequered, career. At every stage Lister took a keen interest in its welfare; we must therefore enquire how and why it was started.

Little has been said of late in these pages about Pasteur, whose inspired labours had in the meantime been crowned by one of his most remarkable discoveries. Having triumphantly proved the efficacy of his attenuated viruses for the prevention of chicken cholera and anthrax,[1] he turned his attention to hydrophobia, then almost as much dreaded in this country as in those parts of the continent, such as Russia and France, where wolves are still found and where, for various reasons, the complete extermination of the disease appears to be impossible. It was dreaded even more on account of the horrible nature of the disease than because of the actual number of deaths; though this was considerable. The average annual number of deaths from hydrophobia in the whole of England was 43, in the decade 1875-1885, and in London alone as many as 8.5.

In 1880 the first two mad dogs had been brought to Pasteur's laboratory by M. Bourrel, an old army veterinary surgeon,

[1] See page 438.

who had long been trying to find a cure for hydrophobia. But it was not till 1882 that Pasteur began his methodical study of the subject, and it was only after three years of ceaseless toil, and then with anxious misgivings, that he ventured, in July 1885, to apply to a human being the preventive treatment which he had proved to be safe and efficacious in dogs.

The little Alsatian boy, Joseph Meister, the first to be treated, has become a historical character. The description of his case in Pasteur's life reads like a romance.[1] Its fame quickly spread throughout the world, and people bitten by dogs and wolves came from far and near, from Russia and America, as well as from England and other neighbouring countries, seeking for treatment at the laboratory. Towards the end of 1885 Pasteur was obliged " to hasten the organization of a ' Service ' for the preventive treatment of hydrophobia after a bite," [2] which in the course of a few years developed into the " Institut Pasteur," for the proper housing of which money soon began to be subscribed.

In 1886 great interest was aroused concerning a batch of nineteen persons who had been bitten by a rabid wolf in Russia, and did not reach Paris till a fortnight afterwards. Sixteen of them recovered. In Russia their return was hailed with almost religious emotion ; but in France more was made of the three deaths than of the sixteen recoveries, and it was suggested that in the fatal cases the disease had been actually caused by the inoculations which were intended to prevent it.

Pasteur, so bold that he could coolly suck up into a glass tube some drops of the saliva of a furious mad dog held down by two powerful assistants, so tender-hearted that he could not bear to see an animal trephined without an anaesthetic, was an uncompromising controversialist, and made many enemies in consequence. As his friend Professor Grancher said :

" Even those revolutions which are the necessary outcome of scientific demonstration invariably leave some vanquished in their

[1] *The Life of Pasteur*, by René Vallery-Radot. Translated from the French by Mrs. R. L. Devonshire, London, Constable & Co. Ltd. 1902, vol. ii. p. 249.

[2] *Loc. cit.* p. 258.

track who find it hard to forgive. Thus M. Pasteur has many enemies scattered throughout the world, without counting the French Athenians who object to one man being always just and always happy. And, as if these adversaries were not enough for him, M. Pasteur makes others by the uncompromising rigour of his dialectic and the positive form in which he expresses his thought." [1]

Grave doubts were raised by these opponents, and bitter things were said about Pasteur's latest discovery. The world naturally hesitated to accept it without more proof. In April 1886 our Government, slowly wise, appointed a Commission to enquire into the subject, of which Sir James Paget was the President, the other members being Dr. Lauder Brunton, Mr. Fleming, Sir Joseph Lister, Dr. Quain, Sir H. Roscoe, Professor Burdon Sanderson, with Mr. Victor Horsley as Honorary Secretary.

At first some of the members at least were sceptical. Brunton, Sanderson and Horsley went to Paris, and returned with material supplied by Pasteur for testing his conclusions by means of experiments. These experiments were carried out by Horsley, who had succeeded to the Brown Professorship at the University of London. They confirmed those of Pasteur, and the Report of the Commission was entirely favourable to his conclusions and positive as to their value.

Hardly was the report out before the House of Lords appointed a select committee on "rabies in dogs." Thirteen peers sat upon the subject with such diligence that in two months (August 1887) they brought in their report—rather a mild one—recommending, amongst other things, that when rabies is present, the muzzle should be enforced in particular districts, that stray dogs should be slaughtered, that the symptoms of rabies should be printed on dog licences, and finally that, in the event of its being conclusively proved that M. Pasteur's system provided a preventive remedy, facilities should be afforded for its application in England. But ten years passed before the Board of Agriculture took the matter up seriously under the powerful influence of Mr. Walter Long. To him belongs the great credit of enforcing prolonged universal muzzling, in the face of strong opposition, and thus,

[1] "Inauguration de l'Institut Pasteur," Sceaux, Charaire et fils, 1888, p. 11.

with the help of an effective quarantine, banishing hydrophobia from the United Kingdom in two years.[1]

The inauguration ceremony of the Institut Pasteur in the Rue Dutot took place in November 1888. By this time its scope had been much enlarged. Its object was the study of the nature and means of prevention of infective diseases, the preventive treatment of hydrophobia still occupying an important though a subordinate position. The Institute occupied between three and four acres of land and included suites of rooms for Pasteur and several assistants, a department for the treatment of hydrophobia, and laboratories where such eminent men as Roux, Metchnikoff and Duclaux carried on their investigations. The funds were mainly derived from private sources, but the French Parliament voted a sum of £8000 towards the initial expenses,[2] and although there was no annual parliamentary grant, £2540 was derived each year indirectly from Government sources. This, together with the amount saved for endowment, made the financial position not indeed easy but sound; which would not have been the case if Pasteur, Chamberland and Roux had not made over all profits resulting from the sale of the vaccines discovered by them. The treatment of hydrophobia was conducted gratuitously.

The Institute was thus in a way, though it must be owned a very small way, a national undertaking. It was the first of many Institutes for the study of infective diseases, now found in all parts of the world. By the time of the inauguration-ceremony there were already in existence many Institutes intended simply for the treatment of hydrophobia—7 in Russia, 5 in Italy, 1 at Vienna, and 1 each at Constantinople,

[1] The actual plan followed was to enforce muzzling over large areas in which the disease existed and to maintain it for six months after the occurrence of the last case. By the spring of 1899 the disease had disappeared in Great Britain, except for one area in Wales; and accordingly, in October 1889 muzzling was everywhere relaxed except in this one Welsh area. Here it was enforced till May 1900, but on its relaxation hydrophobia reappeared and muzzling was again resorted to for a time. In 1902 two deaths from hydrophobia were reported in the United Kingdom. From that time up to the end of September 1915, only two deaths have been registered: one in 1910 of a soldier from a dog bite in Gibraltar, the other in 1911 in Warminster district, which is unexplained.

[2] Letter from Professor Adami to Sir Joseph Lister, December 8th, 1890.

Barcelona, Bucharest, Rio de Janeiro, Havannah, and Buenos Ayres; others were in course of formation at Chicago and Malta; but there was none in England. Anyone bitten by a mad dog in England was submitted to old-fashioned treatment or sent to Paris; and it gradually dawned upon the British public and the medical profession that it almost amounted to a scandal that, between the years 1885 and 1889, more than 200 British subjects had been sent to Paris for the treatment they could not obtain in their own country.

Accordingly, on July 1st, 1889, a meeting was held in the Mansion House, presided over by the Lord Mayor, Sir James Whitehead, "for the purpose of hearing statements from Sir James Paget and other representatives of scientific and medical opinion, with regard to the recent increase of rabies in this country and the efficacy of the treatment discovered by Pasteur for the prevention of Hydrophobia." Letters were read from the Prince of Wales, Huxley and Tyndall; and one from Pasteur pointing out that as England is an island, and as hydrophobia cannot develop spontaneously, "a rigorous observance of simple police regulation" would stamp out the disease in this country. Many distinguished men of science attended the meeting, and Lister was one of the principal speakers. It was resolved that a fund should be opened for a donation to the Pasteur Institute and for the expense of sending patients to Paris; and that the Government should be asked to introduce a Bill for the simultaneous muzzling of all dogs throughout the British Isles, and a quarantine of dogs imported.[1] A Committee was appointed, the labours of which resulted in the collection of a sufficient sum by November 6th, 1889, to allow of £2000 being sent to the Pasteur Institute as an expression of the gratitude of this country, whilst retaining enough to provide for sending necessitous cases to Paris till other arrangements could be made.

After completing its task, this Committee, or rather those members who attended the final meeting, considered informally the desirability of founding in this country an Institute like those in Paris and Berlin. An Executive Committee was

[1] A request which was not granted.

thereupon formed to further this object, including Lister, Huxley, Paget, Roscoe, Michael Foster, Ray Lankester, Horsley, Watson Cheyne and John Sydney Turner, a noted breeder and lover of dogs who, it is said, first suggested the idea. Donations were promised. But eighteen months were occupied in drawing up a scheme, and even then the antivivisectionists tried their best, and for a time successfully, to prevent the Institute from being incorporated. Lister wrote a letter on behalf of the Executive Committee to Sir Michael Hicks Beach,[1] the President of the Board of Trade, in which, after showing that bacteriological Institutes had been provided by the State in France, Germany, Italy, Roumania, Austria, Turkey and Brazil, he said: "The advantages to the Community at large from work in hygiene have led to the endowment of such Institutes with land and capital in order that bacteriological investigations may be carried out by skilled workers under the best possible conditions. The Committee do not expect *that the English Government will do the same for them*, but they may reasonably expect that it will not impede a desirable and scientific scheme." [2]

The petitions of the antivivisectionists had been presented to the Board of Trade, and the only reasons assigned were that it was proposed to perform experiments on animals at the Institute. Lister pointed out that the Committee did not ask the Board of Trade to grant them a licence, because this was the function of the Home Office. All they asked was to be incorporated. Hicks Beach hesitated; he thought the Home Office might have just cause of complaint, but he agreed to receive a deputation. A notable deputation it was, mostly consisting of doctors and men of science, but backed by representatives of widely different interests: the Duke of Westminster, the Earl of Derby, Tyndall, Huxley, Everett Millais, naturalist and sportsman, W. B. Haldane, M.P., Walter Gilbey, horse-breeder and agriculturalist, and many others. It was effectual; and finally, on June 5th, 1891, the British Institute of Preventive Medicine was incorporated, Lister being the first Chairman and Roscoe the first Treasurer.

[1] Afterwards Lord St. Aldwyn.

[2] *Lancet*, 1891, vol. i. p. 1124.

The chief objects of the Institute as set out in the Memorandum of Association were:

(*a*) To study, investigate, discover and improve the means of preventing and curing infective diseases of man and animals; and to provide a place where research may be carried on for the purposes aforesaid.

(*b*) To provide instruction and education in Preventive Medicine to Medical Officers of Health, Medical Practitioners, Veterinary Surgeons, and advanced Students.

(*c*) To prepare and to supply to those requiring them such special protective and curative materials as have been already found or shall in future be found of value in the prevention and treatment of infective diseases.

(*d*) To treat persons suffering with infective diseases or threatened with them, in buildings of the Institute or elsewhere.

It will be observed that these objects are quite general. No special mention is made of hydrophobia, and, as a matter of fact, the treatment of this disease was never undertaken at the Institute, but patients were still sent to Paris until the disease was finally stamped out in 1889.

More than a year passed before sufficient funds were collected, but early in 1893 the Council felt justified in starting their work. The difficulty of finding suitable premises, such as the Home Office would register for experiments on animals, was a formidable one, but it was at last overcome by amalgamation of the Institute with the College of State Medicine, an institution in Great Russell Street, mainly concerned with post-graduate instruction of Medical Officers of Health or those desirous of obtaining public health appointments. The accommodation was far from adequate, but here the work was carried on under the directorship of Dr. Armand Ruffer[1] from 1893 to 1898.

The introduction of the treatment of diphtheria by means of the diphtheria antitoxin in 1893[2] brought increased work to the Institute. A farm was secured at Sudbury where

[1] Afterwards Sir Armand Ruffer.

[2] Klebs and Löffler discovered the bacillus in 1883; Behring and Kitasato discovered the antitoxin, and Roux and Yersin discovered how to filter off the toxin from the bacilli. The date of Roux's and Yersin's work is 1888-1890; Behring and Kitasato, by December 1890, were able to immunize animals against diphtheria. The first human patients treated were in 1893.

the antitoxin was manufactured. Lister wrote to the *Times* appealing for contributions to a special antitoxin fund, which met with a generous response.

Through the influence of the Duke of Westminster, a site for the Institute was secured, at a moderate price, in Chelsea Gardens, on which a new building was erected which was formally opened in May 1897.

The year 1897 was the centenary of Jenner's discovery of vaccination. In December 1896 a meeting was held at St. George's Hospital, at which Lister presided, for the purpose of raising a national memorial to Jenner's memory. A more important meeting, to give this plan a concrete form, was held in March 1897, under the presidency of the Duke of Westminster, at which Lister made a powerful speech in support of the resolution "That a subscription be set on foot with a view of promoting, in connection with the British Institute of Preventive Medicine, but in a manner distinguished by Jenner's name, researches on the lines which he initiated." He dwelt on the inadequacy of the present funds of the Institute, and undertook, on behalf of the Council, that if sufficient money were collected to place them in a thoroughly satisfactory condition and complete the foundation of the Institute, its title should be changed to that of the "Jenner Institute," under which designation, and founded as it might be said at the centenary of the discovery of vaccination, it would constitute a noble national memorial to Jenner. If a smaller but still a considerable sum were raised, he suggested that it might be devoted to founding a Jenner Professorship, or if a still smaller amount only resulted, it might be employed for creating a Jenner Scholarship.

The sum raised was only £5700, of which £5000 was contributed by Lord Iveagh. Nevertheless the name was changed to that of the "Jenner Institute of Preventive Medicine." Unfortunately this change brought it into collision with a firm trading under the name of the "Jenner Institute for Calf-Lymph," and so much trouble resulted that, much against Lister's inclination, in 1903 the name was again changed to that of the "Lister Institute of Preventive Medicine." The money collected for the

Jenner Memorial was employed for the foundation of a Jenner Scholarship.

In the meantime a great change had occurred in the constitution and prospects of the Institute. During the first ten years of its existence the permanent income was hopelessly insufficient for the requirements of a research institute worthy of London; and the expenditure on bricks and mortar had made the outlook far from hopeful. But in 1900 Lord Iveagh came forward with a noble gift of £250,000, which completely altered the situation. Adequate remuneration could from that time onward be offered to a full staff, and it became possible to conduct the manufacture and sale of remedies made at the farm on more business-like lines, so that this part of the work, which had previously involved an annual loss, became a financial success.

The change in the constitution consisted in transferring the administration from a large and unwieldy Council to a Board of seven Governors, of whom three were appointed by the old Council, three by Lord Iveagh, and one by the Royal Society. According to the articles of association Lord Iveagh, and after him his successors, were entitled to one-third of the votes of those present and voting at any meeting of the members at which it was proposed to pass or confirm a special or extraordinary resolution.

The Institute was often thought of, and at one period of its career was spoken of, as a "national" institution, though it never received any direct support from the State. By this last change its administration and, to a considerable extent, its policy were entrusted to a very small body of men.

Lister was the first Chairman of the Governing Body, and afterwards became President of the Institute. He lived just long enough to see the building in its present form, for it was completed in 1910; and until his active life was interrupted by age and infirmities, he took the keenest interest in its doings. Amongst his papers are packets of documents relating to tubercle, cattle disease, and many other matters investigated there, as well as correspondence with the Home Office on the manufacture of calf-lymph and the investigation of the plague. It has therefore seemed right to give a somewhat

detailed account of the origin of the Lister Institute, and for the same reason something must be added concerning the work done there.

The building at Chelsea Gardens contains laboratories furnished for the study of bacteriology, bio-chemistry, protozoology, experimental pathology, entomology, and statistics, together with administrative offices, a lecture-room, workshops, sterilizing plant, hot rooms, a cold room, a library, and a residence for the Director. The main endeavour of the Institute is to further researches in the sciences enumerated in this formidable list, in so far as their application may be of service in the prevention and cure of disease. The researches are carried out by the staff, and by a large number of voluntary workers who are glad to pursue their investigations under the guidance of some member of the staff. The greater part of the expense of these private investigations is defrayed by the Institute.

In addition to these scientific enquiries, the staff devote much time to the analysis of milk for the London County Council, and to the bacteriological examination of blood, sputa, etc., derived from patients suffering from diphtheria, typhoid, phthisis and some other forms of infective disease. This diagnostic work is carried out on behalf of public health authorities and for private practitioners. Of late years much has been done in the way of studying food problems, and much in studying the difficult question of "disease carriers"—those dangerous individuals who unconsciously carry about with them, and distribute at large, such specific organisms as those of typhoid fever, or diphtheria, without themselves apparently suffering any evil consequence whatever. It would be out of place in these pages to give more than this short sketch, which is only intended to show the character of the work now being carried out under the guidance of its present Director, Dr. C. J. Martin, and his staff of over twenty coadjutors.

Amongst these are some whose field of labour is at Elstree, where a better farm than that at Sudbury was purchased when the Institute became prosperous. It extends to twenty-eight acres, and is provided with well-appointed stables and

laboratories for the study and preparation of sera and vaccines. Sera and vaccines of all sorts are made there, from the simple calf-lymph for vaccination against small-pox, to those for protection against deadly diseases such as tetanus and the plague.

This department and that for testing blood, sputa, etc., have developed to such an extent in recent years as seriously to interfere with the atmosphere of serene abstraction which favours profound scientific research. The men of science chafed under the burden, and began to wonder whether it would be possible to get rid of some of the mass of routine work. And quite recently an opportunity seemed to present itself. For when the Government embarked upon its scheme of National Health Insurance accompanied by a system of State-aided research, a strong effort was made to amalgamate the Institute with the national organization for medical research, with certain safeguards as to vested interests.

For the moment, however, the view of those who hold that official red-tape strangles original research prevails; and the Institute has escaped the fate of being merged in a Government Department. But it has only escaped by a vote of the members, among whom are many powerful advocates of the Government scheme. No one can predict the ultimate fate of an Institution which, in its short life, has seen many changes, but it would not be a rash prophecy that, if it should ever lose its independence, it would in time almost cease to be a memorial to Lister, as it has already almost ceased to be a memorial to Jenner.

Amongst Lister's most carefully preserved papers, is a copy of part of a strikingly interesting letter written by the Empress Frederick to King Edward VII., then Prince of Wales. It is dated December 30th, 1890, at which time the Prince was already, as we have seen, deeply interested in the subject of preventive medicine. The King has graciously given leave for it to be published.

"I do so want to call your attention to a matter which has long been on my mind, though of course it is no business of mine. Had our beloved Father been alive I am sure he would have taken it up. I refer to the question of a Bacteriological Institution for England.

It makes me mad when I think that Englishmen have not a chance of pursuing these vital questions of Science, these investigations and experiments, in England, and are obliged to go to Germany and France to study Bacteriology. We ought to have a "Versuchs-station" in England, where every opportunity should be afforded for studying these great questions of the day, half physical, half chemical, half pathology. I know the Vivisection Act rather interferes with this, but still perhaps an amendment might be passed for such an Institution, leaving the Act in force for the rest of the country in general.

Even in Russia they are going to have an Institution to carry on researches on the lines of Pasteur and Koch. Do you know Sir Lyon Playfair's, Sir Henry Acland's, Professor Huxley's and Professor Tyndall's opinion on this subject?

Could you not forward and suggest such a plan? It would help on the development of scientific discovery as applied to medicine immensely and would be a useful competition between the Institutions of different countries, and would stimulate them instead of doing harm. Could not the Government order an official enquiry into the cure and treatment of tuberculosis? I think in future it will be possible to stamp out this terrible disease if the treatment of cattle and the careful disinfecting of rooms and carriages, &c., can be carried out. There is not a doubt that the milk of cows affects tuberculosis and is one great source of the illness in human beings. Its heredity is doubtful, almost impossible, only the general tendency of the constitution to be affected by this Bacillus is hereditary. How infectious it is, is proved by Dr. Cornet's researches at Berlin, who examined the dust collected from the walls, picture frames, furniture and floors of rooms which phthisis patients had been inhabiting. He found this dust swarming with tubercle Bacilli.

Anyone breathing the air in which this dust is contained is liable to infection if they be so constitutionally disposed that way. Any little place which is sore on the hand or face would absorb the Bacillus and develop lupus. It is well to know these dangers. It is also a comfort to think that the greatest safety lies in the greatest cleanliness and care. In this virtue I think the English stand first. The German Government, by stringent regulations and their enforcement, have really almost stamped out small-pox altogether and one rarely ever sees a pitted face in Germany. Consumption, Lupus and Tuberculosis of the bone and even of the eye can be fought with Koch's new remedy and, though the experiments are all too new to form a perfect estimate of what this treatment will do for us, yet I know many of our best doctors think it may lead to the utter cessation of the tubercular disease in future generations.

I thought so much of your Society in aid of the poor lepers that

I think one may hope that something may be done in England to affect this awful scourge as well.

Could you not induce the Government to take the matter up? The Board of Health for instance? This Koch's remedy can only be used in Hospitals under strict medical supervision and, as it is a most deadly poison, there are many phthisis patients who are in no way subjects for this treatment. Their state is a complicated one, other diseases being also present, or they have not the strength to bear the treatment which produces a most violent reaction, and on all these it ought never to be tried.

But if it were possible to have a plot of ground granted or a temporary Hospital erected (perhaps on the 'Hut System' and only for tubercular diseases of all kinds, external and internal) it might be possible to cure a great many and it would be a grand thing. I wish you would think it over, sift the question and see what could be done. In Russia I fancy they also want to establish a temporary special Hospital."

This letter, which shows a remarkable grasp of many complicated medical and hygienic questions, was sent to Sir Lyon Playfair,[1] and by him to Sir Henry Roscoe, and so found its way into Lister's possession.

Roscoe replied, explaining the exact position of affairs at the time with regard to the proposed Institute for Preventive Medicine, and hopefully added:

"I quite agree with the remarks of H. Majesty that our Government ought to take a prominent part in the foundation of such a national Institute, and I cannot but think that the interest which the Empress and H.R.H. the Prince of Wales show in these questions will compel the Government to take some steps to place England in the position which she ought to hold amongst other nations, and that before long we shall see the foundation of an Institute worthy of our country."

The history of the Lister Institute supplies much food for thought: the intelligent interest in these questions shown by the Royal Family, the apathy of the public and their servants the Government, the energy and generosity of a few scientific and philanthropic people, the tardy recognition by the Government of their duties to the governed, and then their desire to absorb the Institute which has at last reached port after many storms, and finally the polite and almost reluctant refusal of the members of the Institute to accept these friendly advances.

[1] Afterwards Lord Playfair.

CHAPTER XXX

HOLIDAYS. END OF PROFESSORSHIP AT KING'S COLLEGE. DEATH OF LADY LISTER (1878-1893)

As the claims of practice became less urgent, and experimental investigations less exacting, in short, as Lister approached and passed his sixtieth year, opportunities for escaping from work increased, and longer holidays were taken and at more regular intervals.

Throughout his life he had a fair share of vacations. The many excursions of his youth and bachelorhood are recorded in ancient carefully written calf-bound diaries, full of minute descriptions, of what he saw, almost in guide-book style, though relieved at times by moralizing or sentiment. All that we know of his holidays after his marriage, but before coming to London, is gathered from a few letters and the evidence of those who still remember his almost boisterous light-heartedness during these brief respites from the engrossing toil of his most strenuous days. Not all of them, however, were short, or times of absolute repose. There was the long wedding tour with its scientific and linguistic studies; the journey to Italy followed by the round of inspection of German medical schools; and the visit to Western America after the Philadelphia Congress.

Often a few peaceful days at Moffat or at Bakewell were devoted to fishing, at which sport he was a diligent amateur though never an expert. During the brief winter holidays at Upton and elsewhere the pleasure of skating became almost a scientific pursuit, though he never passed the stage of cutting eights and threes of small dimensions. In those busy days

work was seldom left quite behind; usually there were proofs to correct, or a paper to get on with, or perhaps some simple experiment that could be carried on away from home. But real idleness was not congenial to him, and if nothing of this sort was required, there was always botany to fall back upon, or a pocket volume of Horace or Dante or Goethe. Many passages from these poets he had by heart, and was fond of declaiming *ore rotundo* to his intimate friends.

Longer and more leisurely, but none the less enjoyable, were the holidays of later years, beginning with that of 1878 and ending with that of 1893, the last which Lady Lister and he spent together. The names of the places they visited are written on a stained old sheet of notepaper, evidently often conned over and added to after this happy period had come to an end. At the time, the events of each day were shortly recorded, mostly in Lady Lister's handwriting, in a number of small note-books; and a large collection of beautifully pressed flowers, all, we may be sure, carefully examined, formed, as it were, a second diary. As his knowledge of birds increased the field-glass became as important as the botanical vasculum, and a daily record of the number of birds seen, or a note or drawing of those they could not identify, as much a part of the day's pleasure as running down the wild flowers or verifying the accuracy of the statements of Murray or Baedeker.

Proofs and the preparation of papers still generally occupied a part of the time, and the meeting of some scientific Society or a foreign Congress often determined the direction of the spring or the summer expedition.

During their first year in London, 1878, they went to Paris for the Exhibition in June; and in the autumn a quiet retreat for the preparation of the paper for the Pathological Society[1] was found at St. Ives in Cornwall, whence Lister wrote to his brother describing their manner of life.

"I have been combining 'study with ease' (as Papa used to say), for I have not even yet quite finished my manuscript for the Pathological Society. It is, however, nearly done; to-morrow will, I expect, finish it; and I must confess that for such work I have been better

[1] See page 442.

here than with the sweet distractions of Lyme. We pulled up on Saturday at Lostwithiel, near the south coast not far within the boundary of Cornwall; and on Sunday had a pleasant quiet Sunday's excursion down the inlet of the sea into which the river Fowey expands (Lostwithiel being on the Fowey) to the ancient town of Fowey, where we attended church, and saw the stone over the grave of Treffry who fought with Edward the Black Prince at the battle of Cressy. Fowey in those times was great, and sent no less than 47 ships to France to aid King Edward's expedition. No other town sent so many except Yarmouth! But thee will say I am quoting Murray (as is true). Yet it was very interesting to see the old place.

On Monday morning we came on here; having seen a notice of the place that seemed attractive for my purposes. And well it has answered. Tregenna Castle was till quite lately a private mansion. It stands in beautiful grounds, with woods adjoining, nice garden, and overlooking the bay of St. Ives. I never saw hart's-tongue fern in such wonderful beauty as it is in the valley or course of a stream that runs through the grounds down towards the shore. The place is a good deal like High Cliff[1] in situation: about as high above the sea, and looking towards the left upon the town of St. Ives, which has its pier, etc. The bathing is most excellent: steeply shelving sand, with rocks on which to dress. I had a grand bathe this morning before breakfast: no one but myself in sight. Various nice walks we have had, and with about 2 hours' work in the morning and 2 hours' in the afternoon, and light reading in the evening, the days pass most pleasantly away."

Next year the meeting of the International Medical Congress at Amsterdam suggested a visit to Norway.

The following passage is from a letter to his brother dated August 11th, 1879, at Faleide. It is in Lady Lister's handwriting; evidently it was dictated.

"Agnes has told of our arrival at Throndhjem. It was a curious thing that the first Norwegian land to greet us on our voyage from Hull was the province of Lister Land, I daresay the source of our Lister ancestors. And most sweet the greeting was; for the wind blew from the shore deliciously fragrant from the pine woods. Closely kindred the people seem to be to ourselves, and especially to the north of England and to Scotland. We are constantly noticing, what we should call in England, Scotch peculiarities in the habits and practices of the people, and also in their language, which seems a sort of half and half between North of England, or Scotch and

[1] The house at Lyme Regis.

German, but a good deal nearer to Scotch. . . . Before coming to Norway I felt not the slightest desire to learn anything of the language, because I thought I could have no possible use for it afterwards. But I felt differently when I found that Norwegian and Danish are identical except slight differences of pronunciation. For Danish medical literature is of considerable value, though hitherto entirely sealed to me except when translated. Thus my friend Prof. Saxtorph of Copenhagen has sent me two volumes of lectures on clinical surgery by himself which have hitherto been absolutely useless through my ignorance of the language. So I thought it worth while to look into it, and got in Christiania a dictionary and a simple little grammar, and soon found the similarity to our own tongue gave it great interest, while at the same time the grammar is extremely simple. One is constantly meeting with explanations of English words. For instance near the head of the Romsdal I sallied forth one evening with my rod and succeeded in capturing some trout in the tumbling blue waters of a noble stream, and on returning to the hotel wanted to have them cooked for supper, and looking up the word "fry" in the dictionary found a Norwegian term which I attempted to pronounce to the hostess, who could speak no English, and she replied, "Oh! at stege dem,' *i.e.* 'Oh, to fry them,' the word stege (to fry) pronounced with the *e* as in French è, being obviously the origin of our word steak. . . .

Yesterday we made a most splendid expedition by the advice of our kind landlord. Starting at 9.30 a.m. we were rowed in a boat for 2 hours to the head of one of the two branches into which the Nord Fjord bifurcates at its upper end; then, guided by our boatman, walked about 2 miles up the course of a large roaring river, the Lu, to where it emerges from a fine inland lake, surrounded by glorious mountains, on some of which glaciers reposed except that now and then masses were detached, falling in apparent dust but with thundering noise. On this lake (Ludals Vand, *i.e.* Ludale water) we took another boat after I had rigged up my fishing tackle, and rowed perhaps a couple of miles up amid indescribable beauties of the mountains reflected in the grey green water, to our intended lunching place, which was a 'sæter' or upland pasture, with its dairy houses. But on arriving there we found the inhabitants absent, and should have been much at a loss but for our boatman guide, who, reaching up to a beam outside the door of one of the houses, obtained its key, and placed on a table before us two large wooden vessels, one containing fresh milk, the other sour milk where bacterium lactis seemed to have done its work very purely while oïdium lactis bloomed over the surface of the cream. Three great wooden spoons, one for each of us and one for the boatman would have been all the utensils for availing ourselves of this provision had it not been for an earthen

cup with wild raspberries which we had bought of a boy at the head of the Fjord, and which served for a dish for Agnes and myself to eat the soft solid sour milk from, while the boatman helped himself direct from the wooden milk pan. This soured milk seems to be a very important article of diet with the Norwegians, and to a hungry and thirsty mortal is wonderfully acceptable and refreshing. We added to it some Peak and Frean's biscuits which we had taken from the hotel, while our boatman chewed alternately soft 'flad bröd' (flat bread), (a sort of thin oat cake though made often of barley and rye rather than oatmeal) and slices of a loaf of black rye bread, which provision he had taken the precaution to bring with him. The wild raspberries and a good draught of the fresh milk completed what proved a most sustaining meal. Having deposited a krone (1$\frac{1}{9}$ shilling) on the table, by our guide's direction, to pay for our repast, we took to our boat again, and guided by our boatman went to the most promising parts of the lake for fishing, viz. on the western side, where the shade of the high mountains protected us from the blazing sun, and several streams pouring into the lake attract the fish to feed, while they rippled the otherwise still water. This latter point, however, was of less importance in consequence of the opalescence of the water of the glacier-fed lake, so that I caught some fish by throwing with a not very long line in perfectly smooth parts. Altogether seven nice trout fell to my lot, the largest weighing about $\frac{3}{4}$ lb., the finest capture I ever made, my little Ilkley rod and Ilkley landing net answering the purpose beautifully, so that though the reel was several times run out a bit the end piece of the rod showed no sign of having been strained. So was crowned the success of a grand expedition; I lent my hand at the oars during part of our return journey on the Fjord, and we reached our hotel about 9.30 p.m. not at all hungry though not at all unduly fatigued."

In 1880, having gone to Toulouse to carry out the experiments on the jugular vein of the ass[1] for which his friend Professor Toussaint provided the material, they made their autumn holiday in the Pyrenees.

In 1881 they took the first of their long spring holidays, which was also the first of several expeditions to Spain. He wrote to his brother from Seville, May 3rd, 1881, describing a pleasant voyage from Oran to Malaga and "a splendid sight of some enormous eagles, one of which sailed over our heads within a few feet of us," the Alhambra, the wonderful

[1] See page 447.

mosque at Cordova which they visited three times, and then he continues:

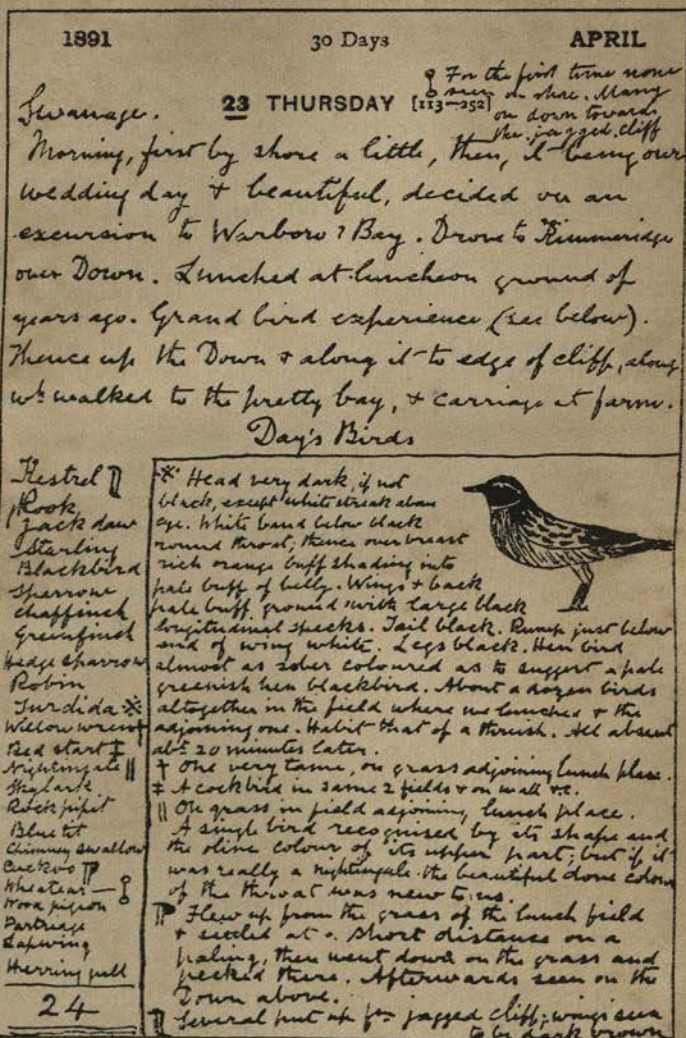
"On Sunday evening we went to Cadiz, in the hope that we might find a steamer to take us direct to London. But as none was going till Thursday we returned the following afternoon to Seville. We are by no means sorry to have visited Cadiz, which is a wonderful city of the waters; and it was very interesting to see in a church there Murillo's last picture, left unfinished because he fell from the scaffolding on which he was working at it, and broke his leg. I suppose it was a compound fracture, for the limb was amputated, and he died in his native city of Seville in consequence of the injury or the operation. It seems wonderful to think that he was only 33 when this happened. . . . We are glad to have taken Andalusia after the north of Spain, which had disappointed us with its bleakness; and altogether our trip may be considered a decided success."

The autumn vacation of this year, spent in the Dolomites, was partly occupied in polishing up his papers read at the London International Medical Congress. In 1882, at Christmas, they went to Barcelona, and after this the attractions of Spain and Portugal induced them to make three other winter visits to the Peninsula, in 1883, 1888 and 1889. It is needless to say that Lister acquired a considerable knowledge of Spanish on these expeditions.

In 1883 they made the first of many visits to Swanage, which, as he would have said, was a much less "sophisticated" place then than now—having no railway in those days. It became almost a habit at Easter-time to seek the retirement of one of its comfortable old hotels; where part of the day could be devoted to literary work, while the rest was spent in rambles along the coast or inland in search of birds and plants.

The manner of life they led there may be gathered from a typical page taken from their short diary, which is reproduced on the following page. It is mostly in Lady Lister's handwriting but the sketch and its description are Lister's own.

These are samples of their many holidays during the fifteen years of their London life, in which they also visited Sicily and the Auvergne, Jamaica, north and south Italy, Switzerland and other places besides those already mentioned.



1891 30 Days APRIL

23 THURSDAY [113—252]

Swanage.

Morning, first by shore a little, then, it being our wedding day & beautiful, decided on an excursion to Warboro ? Bay. Drove to Kimmeridge over Down. Lunched at luncheon ground of years ago. Grand bird experience (see below). Thence up the Down & along it to edge of cliff, along wh walked to the pretty bay, & carriage at farm.

For the first time none seen on shore. Many on down towards the jagged cliff

Day's Birds

Kestrel ‖
Rook
Jack daw
Starling
Blackbird
Sparrow
Chaffinch
Greenfinch
Hedge sparrow
Robin
Turdida ※
Willow wren †
Red start ‡
Nightingale ‖
Skylark
Rock pipit
Blue tit
Chimney swallow
Cuckoo ⁋
Wheatear —
Wood pigeon
Partridge
Lapwing
Herring gull

24

※ Head very dark, if not black, except white streak above eye. White band below black round throat; thence over breast rich orange buff shading into pale buff of belly. Wings & back pale buff ground with large black longitudinal specks. Tail black. Rump just below end of wing white. Legs black. Hen bird almost as sober coloured as to suggest a pale greenish hen blackbird. About a dozen birds altogether in the field where we lunched & the adjoining one. Habit that of a thrush. All absent abt 20 minutes later.

† One very tame, on grass adjoining lunch place.

‡ A cockbird in same 2 fields & on wall &c.

‖ On grass in field adjoining lunch place. A single bird recognised by its shape and the olive colour of its upper part; but if it was really a nightingale the beautiful dove colour of the throat was new to us.

⁋ Flew up from the grass of the lunch field & settled at a short distance on a paling, then went down on the grass and pecked there. Afterwards seen on the Down above.

‖ Several put up fm jagged cliff; wings seen to be dark brown

The year 1890 was one of special interest. It was the year of the meeting of the International Medical Congress in Berlin. In April, Lister and his wife were at Wiesbaden, from which place he wrote to his brother, " I should dearly

like, if it were possible, to get the subject of my address, promised to the Berlin Congress in August, thought out in some degree before I get back to my engrossing work in London." No doubt this address required a good deal of meditation. With this object they went to Swanage and Lyme at Whitsuntide, and later to St. Margaret's Bay, but after all it was not ready in time. When the Congress was over and they were reposing in the Tyrol after their labours, he wrote an account of the meeting to his brother from Villach, August 23rd, 1890.

"I made a promise that I would write and let thee know how matters went with us at Berlin. When I made that promise at St. Margaret's Bay, I had on my shoulders the burden of the approaching Congress with my address as yet unwritten. The time at St. Margaret's was a sort of dulcamara; I had really bitterness of anxiety as to what lay before me at Berlin. But on the other hand the full summer beauty of the cliff and the cornfields 'did all my weary carking care beguile,' and our walks were truly sweet. For the first few days I could not rest satisfied without reading some articles regarding Metchnikoff's phagocyte theory, sufficient to make me feel sure that I was not going upon a false basis in making that theory a chief point in my address. The result was that I was much driven at the last. Part of my address was written in the train between Calais and Cologne, part in the garden of the Cologne hotel, more in the train between Cologne and Berlin, and, last not least, although we arrived at our hotel at Berlin at 1, a.m., and had to take some supper there, we were up at 5.30, and an important part of the affair was written that morning! Had I only known that the address announced to be given at 11 o'clock would not come off till about 3, I might have taken the matter rather more coolly.

However such as it was it was delivered to a kind audience; and I only hope it may do good rather than harm."

The title of this paper, the subject of so much thought though written at the eleventh hour, was "The Present Position of Antiseptic Surgery."[1] It followed the address by Virchow, the President of the Congress, and immediately preceded a communication by Koch on the progress of bacteriology, dealing chiefly with spore-formation and the probability of vaccine-therapy becoming more and more practically useful in the future.

[1] See page 291.

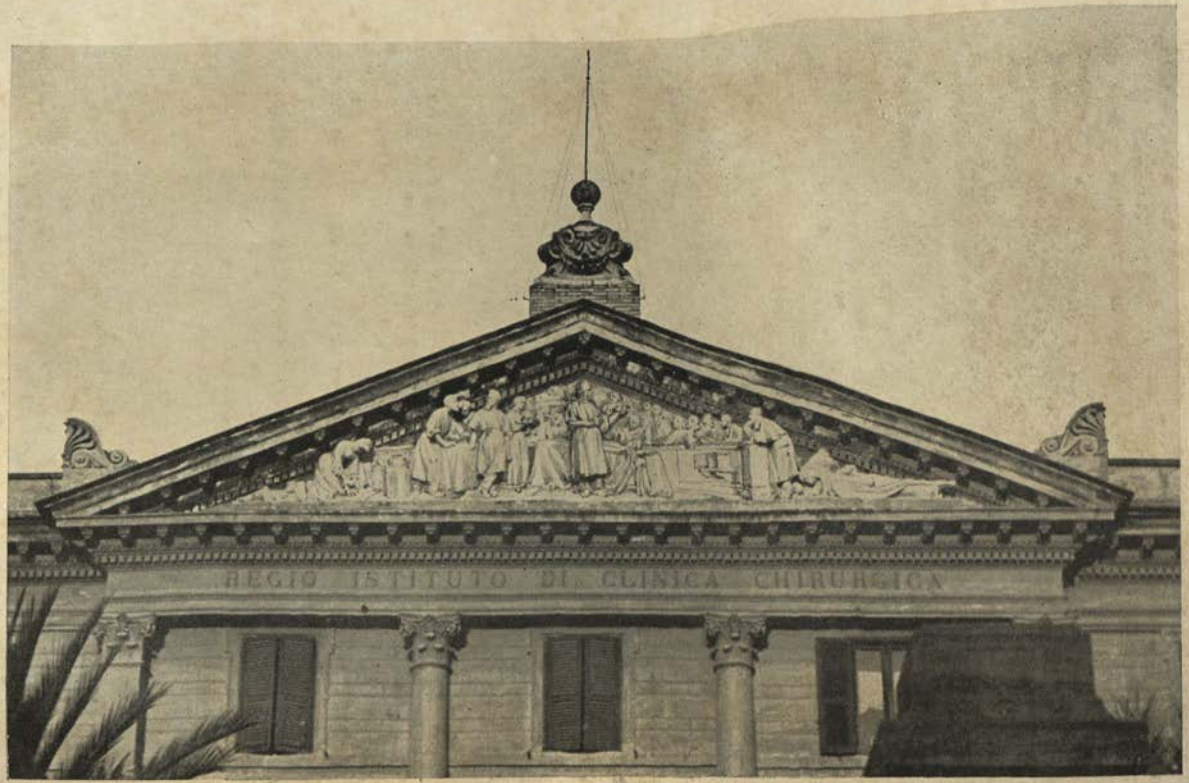
The occasion seems to have been one of mental stimulation and great physical discomfort. It is thus described by Sir James Paget:

"The meeting to-day was the 'biggest crush' that ever I was in. It was in a Circus, as big round as the Albert Hall, but rather low and roofed-in and lighted with gas and electric lamps, having only one entrance and, I think, no windows. And it was cram-full, not less than 5,000 people filling every seat everywhere—Oh! the heat was awful. The business began (but I had previously been at a Committee for nearly an hour) with Virchow's address, very clear and generous and much to the purpose: and then came a series of speeches by three or four officials of the government or of the city, and by eight or ten representatives of different countries, of whom I was one, and the heat was steadily increasing, and handkerchiefs becoming wet through, and faces utterly sad and weary. Then, after some formal elections, and another address from Virchow, the meeting was 'suspended' for twenty minutes, and a vast number rushed-out to get some food at the stalls and counters attached to the Circus; each of us 'grabbed' some veal and bread and beer, and consumed them as we could; and then some of us went back and heard an excellent paper by Lister. It was a strange mixture of science and utter heat and confusion: the mental and the material elements were in wide contrast: but it could all be enjoyed." [1]

Whether "utter heat and confusion" can ever be enjoyable is open to doubt; but Lister certainly appreciated the warmth of his welcome by the members of the Congress.

"As to my reception in Berlin," he says, "it was of the most cordial description possible. This was shown on several occasions. The greeting I received at the opening meeting was one such. Another very special one was at the dinner given on the following day by the German Society of Surgery. About 500 surgeons were at the festival; and it fell to my lot to propose the health of Professor Thiersch, the President of the Society, who in 1875 had got up a banquet in my honour. I alluded to his kindness then, when antiseptic surgery was young, and also to his personal character generally, and I spoke in German, which seemed to please my audience. For when Thiersch proposed my health in return, there was such a storm of applause and such a coming up of surgeons from all parts of the world to touch glasses with me, as was almost overpowering. I was also elected one of the Presidents of the surgical section of the Congress, and had to preside at one of the sittings. Agnes has told to Mary how specially

[1] *Memoirs and Letters of Sir James Paget*, edited by Stephen Paget, London, Longmans, Green & Co., 1901, p. 385.



TYMPANUM OF POLICLINICO UMBERTO I., ROME

honoured I was by the Empress. But enough of this, which begins to look like a dream. Yet I must add an amusing incident. Prof. Baccelli, the chief representative of Italy, and the main author of the great Clinical Institute in Rome, where my effigy is to appear in bas relief on the entrance to the surgical department, on taking leave of me as we came away from Berlin, insisted on embracing me and kissing both my cheeks: which at any rate showed that he did not repent of having given me a place of such distinguished honour in the Institute at Rome."

The bas relief in Rome to which he alludes occupies the tympanum of one of the two principal façades of the Policlinico Umberto I.: that devoted to clinical surgery. Lister is the central figure, standing in a marble theatre by the side of a table on which reclines a patient recently operated upon. He is expounding the case to the audience, while his staff of assistants and nurses occupy themselves with various duties in the background. All are clothed in flowing linen garments such as Lister never wore, but which have enabled the artist to treat his subject in classical style, unhampered by the difficulties connected with modern costume.

1891 was as full of incident as the previous year. On April 20th he wrote to his brother, from Swanage:

"After deciding on the subject of the oration (so called) that I am to give at the Medical Society of London on the 4th of May, I made it my first business to try to get the notice of our father [1] put into shape. I have a good deal shortened that which I gave before, and at the same time made it, I hope, in some respects more complete. Agnes is now engaged copying it.

This morning I have fixed on the subject and title of an address I am to give to the Edinburgh students on the 22nd May as a condition (so to speak) of my having received the Cameron prize from the University.[2] But I can hardly hope to get either of these addresses

[1] This was the obituary notice for the Royal Society, not the longer account of J. J. Lister's "Labours in the Improvement of the Achromatic Microscope," contributed to the *Monthly Microscopical Journal*, 1870, vol. iii. p. 134, and printed in the *Collected Papers*, vol. ii. p. 543.

[2] "The University of Edinburgh has awarded the Cameron Prize in Therapeutics to Sir Joseph Lister for his eminent services to surgery in connection with the antiseptic system. Sir Joseph is to deliver

composed in the time that remains to us here. For I have next to decide on the subject of my promised article for the complimentary volume to be presented to Virchow in a short time in this his 70th year of life. This I *must* WRITE. The other two *may* be done extempore from short notes. It is so dreadfully difficult to get any extra work done at home that I earnestly wish to get this written before we return.

We are having nice little expeditions here in the afternoons. Altogether we have seen 56 species of birds already, not including several commoner kinds which have not turned up and some spring immigrants which have not yet come."

The article for the *Virchow-Festschrift*, "On the Principles of Antiseptic Surgery,"[1] demanded a good deal of thought, part of which was secured by a few more days at Whitsuntide spent at Lyme. The *Festschrift* in honour of some distinguished countryman is a special German institution. The more distinguished the hero at whose feet this tribute is to be laid, the easier it is to obtain contributions from other well-known men. Moreover, these contributions are sure to represent good work, for the writers cannot afford to send anything second-rate to a volume which they know is destined to become a German classic.

Other thoughts were in Lister's mind during these spring holidays of 1891, and he escaped for a few days in the early summer to Ilfracombe and Salisbury in order to mature them. There was to be an International Congress of Hygiene in London in August, and as he was to be President of the Section of Bacteriology he had to prepare a short address in which he proposed to give a summary of the bacteriological work done during the preceding ten years, *i.e.* since the International Medical Congress of 1881.[2]

It was another of those huge congresses of which the reader must be weary. More than 3000 "distinguished" members, mostly English, attended. The Prince of Wales was President, and took an active part in some of its business

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an address on his favourite topic in Edinburgh University early next session." *Brit. Med. Journ.* 1890, vol. ii. p. 471. Lister called it "A brief lesson."

[1] 1891, Bd. iii. p. 259, and *Collected Papers*, vol. ii. p. 340.

[2] *Lancet*, 1891, vol. ii. p. 375.

and social meetings. The material was so copious, and the business so great, and the time so short, that little attempt was made to accommodate foreigners by translating the proceedings. This was sharply criticized in the French press, where it was suggested that the discussion languished in consequence, and proved somewhat unfruitful.

A notable exception was made in favour of the bacteriological section, which received the warmest praise for the considerate way in which its business was conducted. Whatever may be said of the rest of the Congress, distinguished men were not wanting in this section, and they were rewarded by discussions of very great interest. Thus the subject of malaria was introduced by Laveran the discoverer of its microbe, and that of the etiology and toxicology of cholera by Hueppe of Prague. A great debate on "Immunity acquired and natural" was introduced by Roux of the Pasteur Institute, Buchner of Munich, Wright of Dublin and others, and spoken to by Adami of Cambridge, Ehrlich of Berlin, Kitasato of Tokio, Klein of London and Metchnikoff of Paris,—truly a notable discussion and a contest of giants.

The Congress was accompanied by the usual round of festivities, and Lister was glad when the time came to escape to Saas Fee and Pistoja. On his way from Charing Cross he sent this brief account to his brother (August 17th, 1891):

"We are just starting. I have asked Jones to post thee a copy of the *Lancet* of Saturday last, containing, amongst other things, my short address. It is not quite accurately given, having been taken down by their reporter, and I had not the opportunity of seeing a proof. . . . The work of the section was most interesting. Nellie has told thee how Metchnikoff expressed himself as having been greatly interested by thy paper on Badhamia &c.[1] [one of the myxomycetes. Arthur Lister had observed the so-called "swarm cells" of this fungus behaving very much like phagocytes]. He gave a most animated address giving additional evidence of the truth of the phagocyte theory. It came as a wind-up of the discussion on the subject of Immunity, and carried the large audience almost entirely with it; being enthusiastically applauded. We had a very

[1] *Journal of the Linnean Society* (Bot.), xxv. 1890.

cordial dinner party to the German readers of papers[1] (and some Americans) on Friday.

I had a most flattering letter from Dr. Israel the editor of the *Festschrift* for Virchow, saying that my article would be [the] "Stolz" of the work! At all events it is satisfactory that it passes muster.

So now all my tasks in the way of articles and addresses are accomplished and we hope to enjoy some real relaxation."

There is no mention of work during the seven weeks they spent in Switzerland and Italy.

During the spring and early summer of 1892 Lady Lister was at Wiesbaden for more than two months, in attendance on a near relation who was undergoing treatment there. Lister was with them for the first month of the time and went again at Whitsuntide.

The retiring age for the Professors at King's College is sixty-five. In 1892 that melancholy hour struck for Lister; but he continued to discharge his duties during the summer session. His last clinical lecture at the end of July, according to the *Lancet*, "consisted of an excellent *résumé* of the present aspect of the essential parts of the antiseptic treatment of wounds. At the conclusion he spoke with some degree of sadness of the termination of his course as a lecturer, and expressed to the students the hope that in the practice of their noble profession their main object would be to promote the good of their fellow men."[2]

The giving up of the lectures was not, however, all sorrow, as may be easily imagined, notwithstanding the fact that, as the *Lancet* said, he seemed "as active and able as when, twenty-three years ago, he resigned his chair of Systematic

[1] These are the guests who dined at Park Crescent on this occasion:

Frænkel (Königsberg).
Ehrlich, Miller, Weyl (Berlin).
Fodor (Buda-Pesth).
Vaughan (Michigan).
Ponfick (Breslau).
Hueppe (Prague).
Emmerich (Munich).
Kitasato (Japan).
Klein, Cheyne, Hamilton, Horsley, Payne, Hunter, Sherrington (London).

[2] *Lancet*, 1892, vol. II. p. 322.

Surgery in Glasgow to become the successor of Syme in the Clinical Surgery chair of Edinburgh University."

Moreover, the disagreeable feeling of being a superannuated man was softened by the request that he would continue the charge of his wards for another year. This, after some hesitation, he agreed to do, and thus was able to continue his private practice for the same period. He might, of course, have continued this much longer, but he had always determined that, for him, it would be right to give up private practice when he no longer had such opportunities of constant operating and gaining new experience as, for probably the majority of surgeons, are only afforded by the charge of wards in a hospital.

In the autumn, two months were spent wandering about in Scotland and the Isle of Skye: a time apparently of pure recreation. Near its end he wrote to his brother from Glenelg, September 26th, 1892:

"This is a wet day, and I have just turned away from the window of our sitting-room to scribble a few lines to thee. The said window is near the shore and the tide is low, and we can see beautifully with my binocular the various water birds and others that frequent the sand. In a small bay hard by I saw close together three hooded crows, two redshanks, one greenshank, with kittywakes and black-headed gulls: and just now immediately below the window we have been watching a curlew worriting the sand with its long bill and apparently pulling out sand worms, to the disgust of a black-headed gull that follows it about envying its power of getting what the black-headed cannot and now and then trying to drive off the curlew, till warned by the long beak against a near approach. Pretty pleasant employment this for a rainy afternoon! It is well we should have such objects of interest, as we have had a good deal of wet here: but this has been the first day on which the rain has been incessant till 4 p.m. Now it seems clearing and we shall take a stroll.

We have seen other nice water birds, of which we may speak when we meet. And we have got a *few* plants, most of them common enough, though new to me, and two or three rarities from Skye."

Whilst Lister was thus relieved by the mere lapse of years from routine duties, and, being still full of life and energy, was expecting to devote more time than ever to his researches, Pasteur, who was only five years older, broken in health and

worn out by incessant toil, was unable to embark on new enquiries. The campaign against hydrophobia was his last great effort. It had been successfully completed in the later eighties, and he had the rare good fortune of seeing, as Lister had seen, opposition die away and a general acknowledgment of the value of his work and the truth of his teaching, before he quitted the scene.

This public recognition brought about the formation of the Pasteur Institute in 1887, at the opening ceremony of which, in 1888, there had been an opportunity for the expression of those graceful eulogia of which his compatriots are past masters.

And now that his seventieth year had come, all the world united to do him honour. A Pasteur medal was struck, and a great ceremony took place on December 27th, 1892, at the Sorbonne. The large theatre capable of holding 2500 persons was crowded to overflowing. All the ministers of state were present, supported by the members of the Institute, delegates from French and foreign scientific bodies, deputations from agricultural, pharmaceutical, veterinary and other colleges, and admirers from all parts of the country; while subscribers to the presentation about to be made and hundreds of students occupied the galleries.

"At half-past 10 o'clock, while the band of the Republican Guard played a triumphal march, Pasteur entered, leaning on the arm of the President of the Republic. Carnot led him to a little table, whereon the addresses from the various delegates were to be laid. The Presidents of the Senate and of the Chamber, the Ministers and Ambassadors, took their seats on the platform. Behind the President of the Republic stood, in their uniform, the official delegates of the five Academies which form the Institut de France. The Academy of Medicine and the great Scientific Societies were represented by their presidents and life-secretaries." [1]

The President of the Republic opened the proceedings with a short speech. He was followed by the Minister of Public Instruction, the President of the Académie and then

[1] *The Life of Pasteur*, by René Vallery-Radot. Translated from the French by Mrs. R. L. Devonshire, London, A. Constable & Co. 1892, vol. ii. p. 294.

by M. Bertrand, its permanent Secretary. After a few words from the Dean of the Section of Mineralogy, M. Bertrand called upon Lister, who represented the Royal Society of London and the Royal Society of Edinburgh. In the words of the published report, the name of this great English surgeon was greeted by " un ban "—that rhythmical form of applause which is the expression of real enthusiasm on the part of the students.

Lister then gave his address.

" MONSIEUR PASTEUR,

Le grand honneur m'a été accordé de vous apporter l'hommage de la Médecine et de la Chirurgie.

Vraiment, il n'existe dans le monde entier aucun individu auquel doivent plus qu'à vous les Sciences médicales.

Vos recherches sur les fermentations ont jeté un rayon puissant qui a illuminé les ténèbres funestes de la Chirurgie et a changé le traitement des plaies d'une affaire d'empirisme incertain et trop souvent désastreux dans un art scientifique sûrement bienfaisant. Grâce à vous la Chirurgie a subi une révolution complète qui l'a dépouillée de ses terreurs et a élargi presque sans limites son pouvoir efficace.

La Médecine ne doit pas moins que la Chirurgie à vos études profondes et philosophiques. Vous avez levé le voile qui avait couvert pendant les siècles les maladies infectieuses ; vous avez découvert et démontré leur nature microbienne. Grâce à votre initiative et, dans beaucoup de cas, à vos propres travaux spéciaux, il y a déjà une foule de ces désordres pernicieux dont nous connaissons complètement les causes.

Felix qui potuit rerum cognoscere causas !

Cette connaissance a déjà perfectionné d'une façon surprenante le diagnostic de ces fléaux du genre humain et a indiqué la route qu'il faut suivre pour leur traitement prophylactique et curatif.

Dans cette route, vos belles découvertes de l'atténuation et renforcement des virus et des inoculations préventives servent et serviront toujours comme étoiles conductrices.

Comme illustration éclatante, je puis signaler vos travaux sur la rage. Leur originalité était si frappante, aussi bien dans la pathologie que dans la thérapie, que beaucoup de médecins se sont d'abord méfiés de vous. Est-il possible, se disaient-ils, qu'un homme qui n'est ni médecin ni biologiste puisse nous instruire sur une maladie sur laquelle se sont exercées en vain les plus belles intelligences de la Médecine ?

Quis novus hic nostris successit sedibus hospes ?

Pour moi, je connaissais trop bien la clarté de votre génie, le soin scrupuleux de vos inductions et votre honnêteté absolue pour que j'aie pu partager pour un moment de tels sentiments ignobles. Ma confiance a été justifié par l'événement. Avec l'exception insignifiante de quelque peu d'ignorants, tout le monde reconnaît maintenant la grandeur de ce que vous avez achevé contre cette maladie terrible. Vous avez fourni un diagnostic qui dissipe à coup sûr les angoisses d'incertitudes qui hantaient autrefois celui qui avait été mordu par un chien sain, soupçonné de la rage. Rien que ça aurait suffi pour vous attirer la gratitude éternelle de l'humanité ; mais, par votre système merveilleux d'inoculations antirabiques, vous avez su poursuivre le poison après son entrée dans le corps et l'y vaincre.

Monsieur Pasteur, les maladies infectieuses constituent, vous le savez, la grande majorité des maladies qui affligent le genre humain. Vous pouvez donc bien comprendre que la Médecine et la Chirurgie s'empressent à cette occasion solennelle de vous apporter l'hommage profond de leur admiration et de leur reconnaissance." [1]

The dramatic scene which followed the conclusion of this address has been well portrayed by the artist Rixens in a picture the central portion of which is here reproduced.

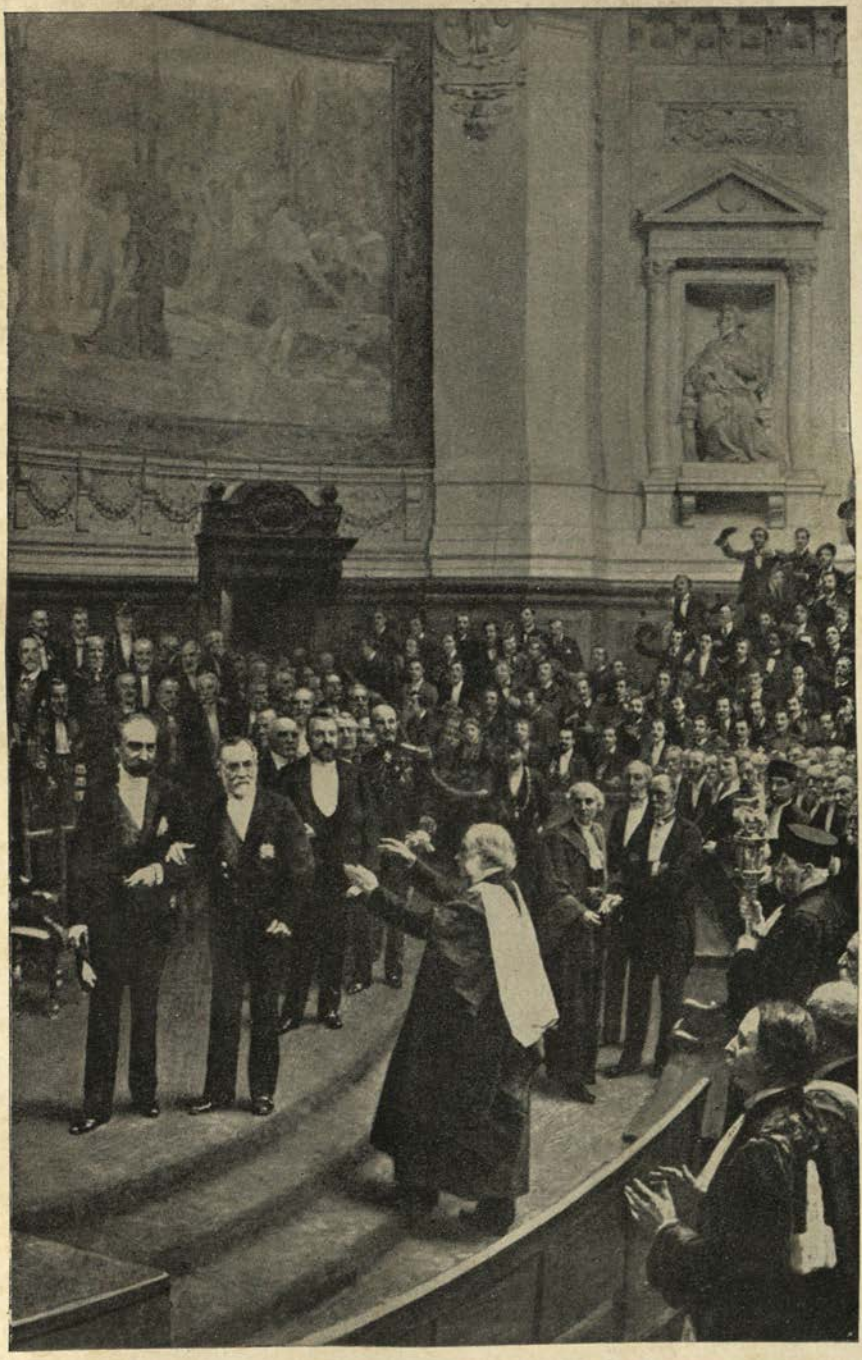
It is thus described : " M. Pasteur se lève pour embrasser M. Lister. L'étreinte de ces deux hommes était comme la représentation vivante de la fraternité de la science dans le soulagement de l'humanité." [2]

The delegates then filed past the table and presented their addresses. There were more speeches, and the ceremony closed with a noble and inspiring reply from Pasteur, who had been sitting, overcome with emotion, his head resting on his hands. As he doubted whether he could make himself heard in the large hall, the reading of it was entrusted to his son. Towards its close he said :

" Les représentants de la Faculté de Lille évoquent pour moi mes premières études sur la cristallographie et les fermentations qui m'ont ouvert tout un monde nouveau. De quelles espérances je fus saisi quand je pressentis qu'il y avait des lois derrière tant de phénomènes obscurs ! Par quelle série de déductions il m'a été permis, en

[1] *Jubilé de M. Pasteur*, Paris, Gauthier-Villars et Fils, 1893, p. 16.

[2] Pasteur rises to embrace Lister. The embrace of these two men was like a living picture of the brotherly unity of Science in the relief of humanity.



CENTRAL PORTION OF THE PICTURE BY M. RIXENS REPRESENTING THE CEREMONY AT THE SORBONNE, DEC. 27, 1892

disciple de la méthode expérimentale, d'arriver aux études physiologiques, vous en avez été témoins, mes chers confrères. Si parfois j'ai troublé le calme de nos Académies par des discussions un peu vives, c'est que je défendais passionnément la vérité.

Vous enfin, délégués des nations étrangères, qui êtes venus de si loin donner une preuve de sympathie à la France, vous m'apportez la joie la plus profonde que puisse éprouver un homme qui croit invinciblement que la Science et la paix triompheront de l'ignorance et de la guerre, que les peuples s'entendront, non pour détruire, mais pour édifier, et que l'avenir appartiendra à ceux qui auront le plus fait pour l'humanité souffrante. J'en appelle à vous, mon cher Lister, et à vous tous, illustres représentants de la Science, de la Médecine et de la Chirurgie.

Jeunes gens, jeunes gens, confiez-vous à ces méthodes sûres, puissantes, dont nous ne connaissons encore que les premiers secrets. Et tous, quelle que soit votre carrière, ne vous laissez pas atteindre par le scepticisme dénigrant et stérile, ne vous laissez pas décourager par les tristesses de certaines heures qui passent sur une nation. Vivez dans la paix sereine des laboratoires et des bibliothèques. Dites-vous d'abord : ' Qu'ai-je fait pour mon instruction ? ' Puis, à mesure que vous avancerez : ' Qu'ai-je fait pour mon pays ? ' jusqu'au moment où vous aurez peut-être cet immense bonheur de penser que vous avez contribué en quelque chose au progrès et au bien de l'humanité. Mais, que les efforts soient plus ou moins favorisés par la vie, il faut, quand on approche du grand but, être en droit de se dire : ' J'ai fait ce que j'ai pu.' " [1]

[1] The representatives of the Faculty of Lille remind me of my early studies in crystallography and fermentation which have revealed to me a completely new world. How great was the hope which inspired me when it dawned upon me that there are laws governing these obscure phenomena ! You, my dear colleagues, have been witnesses to the series of deductions by means of which, as a disciple of the experimental method, I have been favoured to advance the study of physiology. If at times I have disturbed the calm of our Academies by rather lively discussions, it has been because I was passionately defending the truth.

You, lastly, delegates from other nations, who are come from so far to give a proof of sympathy with France, you bring me the deepest joy which a man can feel who believes invincibly that science and peace will triumph over ignorance and war, that men will unite not to destroy but to build up, and that the future will belong to those who have done most for suffering humanity. And here I appeal to you, my dear Lister, and to you all, illustrious representatives of science, of medicine and of surgery.

Young men, young men, put your trust in these sound and availing methods of which we still know only the first secrets. And all of you, whatever calling you may follow, do not let yourselves be touched by disparaging and barren scepticism, nor discouraged by the sorrows of certain hours which pass over a nation. Live in the serene peace of your laboratories and your libraries. Say to begin with, ' What have I done

Pasteur's vision of the future, his belief in the triumph of science and peace over ignorance and war, was, it must be feared, a somewhat academic faith, for he said on another occasion: "Si la science n'a pas de patrie, l'homme de science doit en avoir une, et c'est à elle qu'il doit reporter l'influence que ses travaux peuvent avoir dans le monde." And he was such a fervid patriot himself that in the last year of his life, when it was proposed to submit his name to the German Emperor, for admission to the Prussian "Ordre pour le mérite," he acknowledged with courteous thanks the honour done to him as a man of science, but declared that he could not accept it.

It was like an echo of this Paris celebration when in March 1893 Lister received a telegram from Pasteur, Guyon, and Bouchard, to say that he had been elected an associate of the Académie des Sciences. Bouchard was one of the most distinguished scientific physicians in Paris, and Guyon was equally well known as a scientific surgeon. This distinction is the highest which the French world of science bestows, and it had not, at that time, been awarded to any other living member of the medical profession in this country. The vacancy had been occasioned by the death of Sir Richard Owen.

Soon after this, the usual Spring holiday was taken in that attractive, but not too healthy, part of the world, the southern end of the Italian Riviera. They stayed at Rapallo, which is situated at the foot of a very steep, but rather thickly populated mountain side, covered with vineyards, olive gardens, and chestnut woods, and allowing barely room for the great road and the railway to pass between it and the sea.

They had been there a week or two, botanizing as usual, and thoroughly enjoying themselves, when one morning after breakfast, while they were changing the papers of some

for my own improvement?' Then, as you go further, 'What have I done for my country?'—up to that moment when you shall have, it may be, the immense happiness of feeling that you have contributed something to the progress and the good of humanity. But—whatever favours life may give, or refuse, to a man's work—he must, as he draws near to the end of it all, have the right to say, 'I have done what I could.'"

dried flowers, Lady Lister, who was apparently in the best of health, had an attack of shivering. It was the precursor of acute pneumonia which developed with alarming rapidity, and it was soon evident that her life was in great danger. The Italian doctor, Piaggio, was most attentive. He took a room next to theirs in the hotel so that he might be summoned at a moment's notice; but we can imagine the fearful anxiety which Lister had to pass through without a friend to support him, without a nurse and with no English doctor to encourage and advise him. When the end came, after about four days, the shock was terrible; and then, all alone, he made the arrangements for the mournful, and as it turned out difficult, journey to England, and faced the desolate home-coming.

From this time forward Lister was a solitary man and the whole course of his life was altered. As they had no children, his wife had been his only intimate daily companion for thirty-seven years, sharing all his joys and anxieties, exulting in his triumphs, and watching over him with almost a mother's care.

But this was not all. She entered into his scientific work with intelligent interest, and was never tired of sitting by his side, taking down notes to his dictation, waiting patiently, pen in hand, for the moment of inspiration, or the complete maturing of an observation. The ponderous "common place books" are mostly in her handwriting, and only those who have been privileged to write a few pages in them can appreciate the amount of patience which was required. It was tedious work, even if the scribe was well acquainted with the subject and keenly interested in the research, for Lister was extremely deliberate in coming to his conclusions and no less careful in choosing his words in small matters than in great. Moreover, the fear of making a mistake through undue haste increased when the promised hour for relaxation had passed, or as the small hours of the morning lengthened out. At such times she showed no signs of impatience, which others might find it difficult to restrain. She wrote in the same neat and careful manner, and was as ready as ever, though with great humility, to offer suggestions

as to phraseology or even matter, showing, though she seldom spoke of his work, that she thoroughly understood what was in progress.

Though not accomplished as a musician or an artist, she was a good linguist, and her mind was stored with knowledge kept well up to date. After dinner, if the day's work was over, or even if it was intended to devote the night to experiments, Lister was packed away on the sofa and covered with a shawl, while she read aloud some book, serious or light, read him in fact to sleep as a preparation for bed or for the laboratory.

A love of birds and flowers formed only a small part of the tastes and interests which they had in common. But all these things seem trivial in speaking of one whose most striking characteristic was to make all who knew her respect and love her. Taken, however, with the many references to her in preceding pages, they may help to show how completely her life was bound up with that of her husband, and his with hers, and how imperfect any picture of his life would be that did not suggest her constant presence at his side. When they were starting in life, Dr. John Brown, contemplating their future, and looking back upon a childish illness of hers which involved several days of complete unconsciousness, said: "Lister is one who, I believe, will go to the very top of his profession and, as for Agnes, she was once in Heaven for three or four days when she was a very little child, and she has borne the mark of it ever since." [1]

[1] *Lord Lister*, 1827-1912. An Oration by Sir Hector Cameron. Delivered in the University of Glasgow on Commemoration Day, 23rd June, 1914. Glasgow, James MacLehose & Sons, 1914.

CHAPTER XXXI

RETIREMENT FROM KING'S COLLEGE HOSPITAL. PRESIDENCY OF THE ROYAL SOCIETY. ADDRESS TO GLASGOW STUDENTS. PRESIDENCY OF THE BRITISH ASSOCIATION

(1893-1896)

DURING the summer of 1893 Lister did not allow his great grief to interfere with public or private duties. He was still in charge of wards at King's College Hospital, but the end of the session brought to a close this congenial occupation of his time and wholesome distraction of his thoughts. At the same time private practice almost entirely disappeared.

The brightness had gone from his home; but he was not quite alone, for his sister-in-law, Miss Syme, continued to live with him. Without the loving sympathy and encouragement of his wife he had little heart for experimental work, as the scarcity of notes in the "common place book" testifies. Social gatherings at Park Crescent also came to an end, and with very few exceptions were never renewed.

Thus it seemed as if the period of "well-earned repose," which young people speak of so glibly, but which those who have attained to it contemplate with more anxiety than pleasure, was destined to be for him a melancholy and possibly an unfruitful time.

It was therefore a happy thought of some of his friends amongst the more influential Fellows of the Royal Society, that he should be nominated for the office of its Foreign Secretary on the retirement of Sir Archibald Geikie. He was very sad and depressed at the time, and gave them to

understand that he had no heart for such an appointment, but at last he yielded, and was duly elected in November 1893.

Lister's connection with the Royal Society began when he was quite a young man. His father being a Fellow, and his friend Sharpey an active participator in its affairs, the thought of presenting some of his early papers to the Society naturally occurred to him. Four were accepted during the years 1857-1858, three of which appeared in the *Philosophical Transactions*, and one in the *Proceedings*.

He was elected a Fellow in 1860 at the early age of thirty-three.

Three years later he gave the Croonian Lecture on the Coagulation of the Blood.

In 1880 he was awarded one of the two Royal Medals which are given annually. It was fourteen years since any one engaged in the active practice of medicine or surgery had received this recognition of his scientific work by the Royal Society.

From 1881 to 1883 he was a Member of Council, but beyond this he took no active part in the work of the Society during his first fifteen years in London, except that which is involved in occasional attendance at the meetings.

His appointment as Foreign Secretary thus opened up a completely new field of interest. The duties of this post are not onerous, involving only a certain amount of correspondence with foreign countries and attendance at the meetings of the Council. He continued to act in this capacity for two years, in fact until he became President. The intercourse with others which this necessitated no doubt did something to lighten the weight of his ever present sorrow, and in after years, though he never regained his former buoyancy of spirits, he was able in a measure to enjoy life, especially when some congress or scientific function, or the need of change, took him into other lands.

In 1895 he succeeded Lord Kelvin in the Presidency, which he held for the usual period of five years. Only once before had a surgeon been President of the Royal Society.[1]

[1] Sir Benjamin Brodie (1858-61).

On St. Andrew's day, in each year, he delivered the annual address at Burlington House; besides the presidential speech at the Royal Society dinner,—a still more difficult performance, for the banquet is attended by a large number of guests, and yet the President must treat of technical and domestic matters, including the work of the most notable Fellows who have passed away during the year, and that of the recipients of the Society's medals.

The outside world knows nothing of what takes place in the council chamber of this august Society, but we know that Lister was surrounded by a strong body of very distinguished men, and that this was for him a source of gratification and pride. It is whispered that amongst these learned colleagues he was always a doctor: that is to say, that he always took the doctor's point of view, which seems to suggest that the doctor's standpoint is not always identical with that of the followers of pure science. Be this as it may, his presidential addresses have no restricted outlook, but range over almost all the sciences, and are a monument to the width and depth of his reading and thinking.

Sometimes he apologised for "seeming to dwell too much upon matters connected with the healing art," as when in 1897, after telling how he had approached the India Office on the subject of Yersin's treatment of bubonic plague, and of the cordiality with which he had been received, he turned to another medical topic, that of glycerinated vaccine-lymph, and discussed it at some length. It naturally interested him very much, being closely allied to those subjects which he had himself done so much to elucidate, for it had been shown that the addition of glycerine to calf lymph causes the disappearance of those microbes, sometimes accidentally present, which are responsible for such complications of vaccination as tubercle and erysipelas. The sheet anchor of the anti-vaccinationists had thus been cut away.

Similarly, in 1899, he spoke with the appreciation of an expert on the question of serum-therapeutics as applied to the treatment of cattle plague, and on Mr. Chamberlain's enlightened action regarding rinderpest, malaria, and other

allied disorders, and dwelt with satisfaction upon the enormous number of cattle saved in South Africa owing to the work of Koch, Kolle and Turner.

Again, in 1900 a considerable part of his address was devoted to a certain "Meeting for Discussion," in which Haffkine brought before them his experience and views regarding preventive inoculation against cholera and the plague.

The importance of medical science was still more emphasized in the last of these addresses, in 1900, nearly half of which was devoted to a careful summary of the work of the Malaria Committee of the Society, appointed in 1888. He concluded with these words: "In a communication to this Society it is the scientific side rather than the practical that is naturally chiefly dwelt on. Yet I should have been glad, had time permitted, to have referred to the various measures of prevention and treatment of malaria, which the light of recent knowledge has suggested, and which have already borne important fruit. I must now content myself with saying that, very various as these measures are, they are all, without exception, based on the 'mosquito theory.'"[1]

The business of the Royal Society and the public duties which devolve upon the President, occupied, not unpleasantly, much of his time up to the end of 1901. Only one of these, which occurred during his first year of office, need be mentioned.

The year 1897 was the second Jubilee of Queen Victoria. Her Majesty, on account of her advancing years, did not feel equal to receiving in person all the deputations desirous of presenting addresses of congratulations. The Royal Society amongst others was cut out of the official list, but it was felt that a protest should be made against the exclusion of the highest scientific body in this country. After some correspondence between Lister and the Lord Chamberlain the point was yielded, and the deputation was received—a very distinguished one, consisting of all the Officers and all the Vice-Presidents and three former Presidents: Sir Joseph Hooker, Sir George Stokes and Lord Kelvin.

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[1] *Year Book of the Royal Society*, 1901, p. 164.

Many other matters besides those connected with the Presidency of the Royal Society combined to make Lister at this time an increasingly busy man. After he had finished with hospital practice he was more and more forced to take a prominent part in public ceremonies, and the many occasions when his fellow-countrymen assembled to do him honour became almost burdensome.

In May 1894 he fulfilled a long promised engagement to visit Glasgow, and gave an address to the Glasgow University Medico-Chirurgical Society, a students' Society, in the Hall of the University Union. His theme was the simplification of the antiseptic treatment. He told his audience of some of the more recent almost incredible discoveries with regard to phagocytes and leucocytes made by Werigo in Metchnikoff's laboratory: how, for example, when anthrax bacilli are injected into a vein and the animal is killed 1½ minutes after the completion of the process, nearly all the bacilli have been devoured by the phagocytes, and how, in 7½ minutes after an injection, the digestion of the bacilli is already far advanced in the endothelial cells of the liver. "Such facts as these," he said, "give us an altogether new idea of the amazing rapidity with which the process of phagocytosis, the devouring and digestion of the microbes, may go on." These and other startling facts were used to illustrate the defensive powers of the living tissues and to explain why the elaborate precautions against air-infection, such as the spray, formerly thought to be essential, had been given up; and why, in his opinion, there was no more to be said in favour of the many complicated measures against skin infection which the surgical world were talking about at the time and the merits of which they were hotly debating. And then he asked how it was that any wound made by any surgeon ever went wrong, seeing that the atmospheric dust might be neglected and purification of the patient's skin, the operator's hands, and the instruments, was now such a simple matter. It was a question well worth asking, but he was grieved to have to say, now that the end of his surgical career was approaching, that there were still only a few surgeons who obtained the results that the antiseptic treatment

ought to yield. "Depend upon it," he added, "if gentlemen get bad results, it is not because they have not purified the skin for a sufficient length of time, or because they have not irrigated the wound sufficiently. No, it is because they have not been sufficiently careful to avoid the introduction of gross dirt into the wound." This error might be committed in various ways. There might be dirt on the teeth of the forceps. For his part, he made it an invariable rule to brush the teeth of the forceps with a nail brush. A strong watery solution of carbolic acid, applied for a quarter of an hour would infallibly destroy all micro-organisms.[1] But he had repeatedly seen, when watching the practice of others, instruments placed in a purifying bath with perhaps not more than half their surface covered by the antiseptic solution. "Either the thing should be done properly or not at all."

And so he continued,—protesting against the careless and perfunctory way in which carbolized towels placed round the field of operation were allowed to become displaced, and therefore useless, before the operation was completed; and against the promiscuous and thoughtless manner in which the different antiseptic dressings were employed, "as if, so long as the thing was called antiseptic, it did not much matter what was used." And yet the gentlemen whose practice was so loose would perhaps say that they had used "ordinary antiseptic dressings." The slipshod surgeon was Lister's blackest of *bêtes noires* and he certainly was not spared on this occasion.[2]

He had received a great ovation at the opening of the meeting, and the students, to whom the address was specially delivered, as well as the professors, listened, it is said, with rapt attention. At the conclusion of the meeting the excited students clasped hands and sang "Auld Lang Syne," in which performance Lister joined. Afterwards their enthusiasm overflowed in other typically Scottish ways, which he described in a letter to his brother (May 18th, 1894):

[1] This we now know is not strictly true.

[2] There are manuscript notes of a small part of this address, but it was mostly delivered extempore. It was not published, and the only account of it is an obviously uncorrected report in the *Glasgow Medical Journal*, 1894, vol. i. p. 434.

" I should have written at once . . . had I not been pressed with the prospect of my promised visit to this place. Circumstances over which I had no control occurred to compel my attention to other matters than the preparation of my address; and when I started on Wednesday morning from Euston station, all remained still to do, except some little thought of the form the thing should take and collecting and packing papers containing details I wished to refer to.

Happily I had a small compartment in the train to myself: and was able to read over in my journey the remarkable papers on phagocytosis which I have spoken to thee about, and mark some passages containing statements I wished to quote. And I also got some idea of my opening sentences.

Yesterday morning and afternoon I spent in my bedroom in this hospitable house [Hector Cameron's], working hard at preparing for the inevitable occasion of the evening. I think I never was so pressed before. I wished to speak of the experiments showing how greedily epidermis and oily matters take carbolic from a watery solution; and I only got my facts from my notes on the subject by stealing away, ten minutes before we had to start for the College, from Dr. Cameron's dinner table to which he had invited several students and some practitioners to meet me. More than two-thirds of what I said was without a note to guide me.

Yet, though I could have greatly wished for much more perfect preparation, I managed to get said what I wanted, and the occasion is considered to have passed off really successfully.

Certainly nothing could have been more enthusiastically cordial than my reception by the present students who filled the body of the large hall, and former pupils who in large numbers occupied the galleries. When the meeting ended, the students must needs unyoke the horse of my cab and draw and push me by a circuitous route to this house," [where, it is said, there was more singing of the inevitable " Auld Lang Syne " before they withdrew].

The experiments on the avidity with which epidermis and oily matters absorb carbolic acid, referred to in this letter, were never actually published, and a search for notes of them in the " common place books " and elsewhere has been fruitless. Lister frequently spoke of these experiments and they are mentioned in his very latest publication on antiseptic surgery.[1] They had a very practical bearing upon surgery.

[1] " Remarks on some Points in the History of Antiseptic Surgery," *Lancet*, 1908, vol. i. p. 1815, *Brit. Med. Journ.* 1908, vol. i. p. 1557. *Collected Papers*, vol. ii. pp. 370, 371.

This was one of them. Some human hair was packed closely into a test tube; then just enough 5 per cent. solution of carbolic acid in water to cover it, was added,—eight times the weight of the hair being required for the purpose. In half-an-hour nearly half the carbolic acid had been extracted from the watery solution by the hair. This remarkable property was retained by the hair even after all oily or fatty matter had been removed by steeping it in ether.

He used to tell of another experiment in which a tube open at both ends was packed with hair, and, whilst it was placed in the upright position, a watery solution of carbolic acid was poured into the upper end. For some time the liquid which had passed through this hair filter contained no carbolic acid at all.

He took hair as a typical epidermic structure for these experiments, and he based upon them his advocacy of carbolic acid as the best agent for rendering the skin aseptic. He also pointed out that skin and, what was more important, hair, owing to this property, could be made actively antiseptic and be actually used as an antiseptic dressing. Thus, though shaving the field of operation might be aesthetically cleanly, and generally save trouble, he said that it was never essential; and that, when small operations had to be performed on the scalp, it was really best, from every point of view, to leave the hair uncut and to use it to supplement the antiseptic dressing, or even to use no dressing at all and trust to the protection afforded by the carbolized hair.

In the autumn of 1894 a number of Fellows and Members of the Royal College of Surgeons united to obtain a portrait of Lister to add to the large collection the College already possessed. The work was entrusted to Ouless, and the picture, which was presented on March 29th, 1897, now hangs in the front hall of the College in Lincoln's Inn Fields.

In the meantime another scheme for giving him a testimonial portrait was started chiefly in connection with King's College. In this case Lorimer was the artist. The presentation was made at King's College by his old teacher Sir John Erichsen, who delivered one of his characteristic, graceful

speeches on the occasion. This picture used to hang at Park Crescent, and is now at the end of the Library Hall of the University of Edinburgh. A replica may be seen, though in its present position not to the best advantage, in the library in the University of Glasgow. The sombre colouring and the more than sombre expression do not give a true impression of Lister, even in his gloomiest moments—such moments as he never experienced until the last sad years of his life. Ouless's portrait is much happier and a much truer representation of a more habitual expression. If it errs it is on the side of too bright colouring. The complexion is perhaps too fresh and the colour of the eyes too blue. But on the whole it is a satisfactory portrait. There are copies of it in the Lister Institute and at the House of the Royal Society.[1]

In 1896 Lister was President of the British Association, which met that year at Liverpool. The subject of his address was "The Interdependence of Science and the Healing Art."[2] He did not attempt a complete review of this relationship, but gave a few striking illustrations from recent times, choosing, as was natural, those in which purely scientific investigations had led to the advance of surgery. First he touched upon the then recent discovery (in 1895) of the Röntgen rays, the bearing of which upon diagnosis and treatment was only beginning to be suspected. Then he spoke of the discovery of anaesthesia just fifty years before. After this he told concisely the story of Pasteur's work on fermentation, which led up to a fuller account of what he had himself accomplished with the aid of Pasteur's discoveries. It was the first time he had spoken on this subject before a popular audience, and he explained his previous reticence in these words: "Pasteur's labours on fermentation have had a

[1] No other portraits of him were painted during his lifetime. The medallion in the Glasgow Infirmary was not from life, and is by no means a good likeness. The bust at the Royal College of Surgeons and the medallion in Westminster Abbey, both executed by Sir Thomas Brock after Lister's death, are extraordinarily good. They are monuments of the skill of this distinguished sculptor.

[2] *Collected Papers*, vol. ii. p. 489.

very important influence upon surgery. I have been often asked to speak on my share in this matter before a public audience; but I have hitherto refused to do so, partly because the details are so entirely technical, but chiefly because I have felt an invincible repugnance to what might seem to savour of self-advertisement. The latter objection now no longer exists, since advancing years have indicated that it is right for me to leave to younger men the practice of my dearly loved profession. And it will perhaps be expected that, if I can make myself intelligible, I should say something upon the subject on the present occasion." He went on to show how Pasteur's purely scientific observations had led to his own practical application of them. He explained his early complicated methods and how it had come about that new scientific discoveries had led to their great simplification. And then after telling what had been accomplished in the way of saving life, banishing septic diseases and advancing surgery, he continued:

"It pleases me to think that there is an ever-increasing number of practitioners throughout the world to whom this will not appear the language of exaggeration. There are cases in which, from the situation of the part concerned or other unusual circumstances, it is impossible to carry out the antiseptic system completely. These, however, are quite exceptional; and even in them much has been done to mitigate the evil which cannot be altogether avoided.

I ask your indulgence if I have seemed to dwell too long upon matters in which I have been personally concerned. I now gladly return to the labours of others."

The next part of the address was devoted to Pasteur's work on the attenuation of viruses,[1] and especially to the application of this principle to the treatment of hydrophobia. He reminded his audience also that it was the centenary of Jenner's discovery of vaccination, and that it had passed unnoticed by his practical fellow countrymen who are "not much addicted to personal commemorations." "But," he said,

"while we cannot be astonished that the centenary of Jenner's immortal discovery should have failed to receive general recognition

[1] See page 491.

in this country, it is melancholy to think that this year should, in his native county, have been distinguished by a terrible illustration of the results which would sooner or later inevitably follow the general neglect of his prescriptions."

This referred to an outbreak of smallpox in unvaccinated Gloucester. He continued:

"I have no desire to speak severely of the Gloucester Guardians. They are not sanitary authorities, and had not the technical knowledge necessary to enable them to judge between the teachings of true science and the declamations of misguided, though well-meaning enthusiasts. They did what they believed to be right; and, when roused to a sense of the greatness of their mistake, they did their very best to repair it, so that their city is said to be now the best vaccinated in Her Majesty's dominions. But though by their praiseworthy exertions they succeeded in promptly checking the raging epidemic, they cannot recall the dead to life, or restore beauty to marred features, or sight to blinded eyes. Would that the entire country and our Legislature might take duly to heart this object lesson!"

From vaccination he passed to the work of Koch, Behring, Kitasato and others, on tubercle, cholera, and other infective diseases, and then briefly discussed the whole theory of treatment by vaccines and serums.

Lastly, he came to Metchnikoff's discovery of phagocytosis, and showed how this explained healing by first intention under circumstances where it had formerly appeared to him to be incomprehensible,—that is, when the wound was covered with a plain water dressing, which, though "cleanly when applied, was invariably putrid within twenty-four hours." But not only so, it also explained the complete success of the antiseptic treatment as practised at that day. For, as he said in conclusion:

"If phagocytosis was ever able to cope with septic microbes in so concentrated and intense a form, it could hardly fail to deal effectually with them in the very mitigated condition in which they are present in the air. We are thus strongly confirmed in our conclusion that the atmospheric dust may safely be disregarded in our operations; and Metchnikoff's researches, while they have illumined the whole pathology of infective diseases, have beautifully completed the theory of antiseptic treatment in surgery.

I might have taken equally striking illustrations of my theme from other departments in which microbes play no part. In fact any attempt to speak of all that the art of healing has borrowed from science and contributed to it during the past half-century would involve a very extensive dissertation on pathology and therapeutics. I have culled specimens from a wide field; and I only hope that in bringing them before you I have not overstepped the bounds of what is fitting before a mixed company. For many of you my remarks can have had little if any novelty; for others they may perhaps possess some interest as showing that Medicine is no unworthy ally of the British Association—that, while her practice is ever more and more based on science, the ceaseless efforts of her votaries to improve what have been fittingly designated *Quae prosunt omnibus artes*, are ever adding largely to the sum of abstract knowledge."

The matters dealt with were perhaps more than usually technical for a mixed audience. But the British Association is never better pleased than when its President provides a tough morsel in his opening address, and the British public always welcomes a peep into the arcana of medicine, if only it is presented to them in comprehensible language. At all events the meeting was more than satisfied, the public approved, and writers of leading articles joined in a chorus of praise. The *Times* of September 17th, said, amongst other complimentary things,

"Sir Joseph Lister is, as far as we remember, the first President of the Association who has so distinctly accepted the limitations of knowledge as to confine himself entirely to the interdependence of Science and of the Art which he has practised with such distinguished success and with such signal benefit to humanity. He was compelled by the nature of his subject to speak of himself and of his own work; but he did this with such modesty and reticence that none who were unacquainted with the subject would gather from his words the extent to which he has been a benefactor to mankind."

This was Lister's last great address on the subject of antiseptics. Henceforward the improvements, the simplifications, and alas! the complications, were to be worked out by other minds. The practice of 1896 was widely different from that of 1865, and many further changes have been made in the last twenty years. From time to time I have endeavoured

to explain how and why the various modifications in practice were introduced. These explanations have often been widely separated from one another, and it may have been difficult to keep in mind the continuity of the succeeding steps. If, however, the attempt to show this continuity has been successful, the reader will leave the subject with the same confidence in the truth of the great principle that underlies the antiseptic treatment as Lister felt and expressed on this occasion.

In the closed book of the future it is impossible to read what new means may be devised for dealing with pernicious microbes; but even if some wonderful plan[1] should be evolved which renders unnecessary all the precautions now taken by antiseptic and aseptic surgeons—a most unlikely contingency—that would not upset the basis of the antiseptic system nor diminish the credit due to Lister for providing the first successful method of preventing the septic infection of wounds.

Pasteur's death in September 1895 was a cause of national mourning in France. He was accorded a public funeral, and his body was placed in one of the chapels of Notre Dame; but only for a time, for a beautiful chapel, modelled after the tomb of Galla Placidia at Ravenna, was prepared for him within the precincts of the Pasteur Institute. Here, when he was laid to rest in January 1896, there was another ceremony at which Lister was present and paid this tribute to his memory:

"Je suis chargé de représenter la Société Royale de Londres, le Collège Royal des Chirurgiens d'Angleterre, et la Société Médico-Chirurgicale de Londres. Aussi j'ai fait déposer, de la part de l'Institut Britannique de la Médecine Préventive, fille de l'Institut Pasteur, une couronne ici.

Il y a quatre ans, à l'occasion du jubilé de Monsieur Pasteur, j'ai eu le suprême honneur de lui présenter, au nom de la Médecine et

[1] It has been suggested for instance, that as many microbes cannot resist a temperature of 103° or 104° F. for more than a short time, it might be possible to put an abrupt end to their existence by artificially raising the temperature of the patient to the required height and maintaining it for the necessary number of hours.

de la Chirurgie du monde entier, l'hommage de leur reconnaissance. Aujourd'hui j'assiste à ses funérailles ! Cette cérémonie est noble et imposante, digne de la mémoire de notre vénéré maître. Mais elle nous remplit d'une profonde tristesse, puisqu'elle nous rappelle que cette grande lumière de la science, si ardente et si claire, est éteinte ; que ce caractère si noble et si aimable, a disparu de notre monde." [1]

[1] *Lancet*, 1897, vol. i. p. 64.

CHAPTER XXXII

HOUSE OF LORDS
(1897-1900)

THE memorable year 1897, Queen Victoria's second Jubilee, was that of Lister's elevation to the peerage. The appearance of his name in the list of New Year honours was hailed with delight by the medical profession at home and abroad; for it had long been a matter of complaint that, while all other professions were largely represented, no followers of medicine had ever been admitted into the gilded chamber. Were they less worthy of recognition, it was asked, less worthy of the honour than members of the fighting services, than successful lawyers, or eminent ecclesiastics, or than those whose claims rested upon ancient pedigrees, mere wealth, or political activity? Even those who profess to doubt the utility of the House of Lords as a part of our constitutional machine do not deny the value and high tone of its debates; yet, it was pointed out, no peer was competent to speak with authority on the all-important questions of public health and sanitary science, which increasingly demanded the thoughtful attention of the legislature. It was hoped that when once the spell was broken the advantage of this innovation would be recognized, but nearly twenty years have passed, and the precedent has not been followed. After all it was not exactly the precedent the medical profession supposed it to be; for Lord Salisbury in his letter dwelt upon the extraordinary services which Lister had rendered to *science*. He did indeed add "and especially to the beneficent science with which you are professionally associated," but he ended by saying, "and I have no doubt

it will be received with approval by the distinguished men over whose scientific labours you preside." This of course referred to the Royal Society, and thus made it clear that the distinction was given rather to science than to medicine; and it was not the first time that scientific eminence had been rewarded by a peerage.

Telegrams and letters of congratulations poured in from all parts of the world. A few, chiefly interesting as coming from distinguished men of science, were preserved. Two of these may be quoted, one from an old colleague and one from perhaps the best known American physician of his time.

Lord Kelvin wrote from Glasgow on January 10th:

"Telegraphic brevity did not allow me to say half what I would have liked to say when I first saw the announcement of the honour that the Queen had conferred on you, and I did not like to trouble you with a letter when I knew you would be flooded by telegrams and letters. Three days ago it was a great pleasure to me in our Senate meeting to join in congratulations so cordially felt by all of us; and I may certainly say most of all by myself and my four colleagues, Caird, Gairdner, Young, and Ramsay, who remember *you* as a colleague and feel natural pride in being thus associated with you when you were working out and bringing into successful practical use the antiseptic method.

I am particularly pleased that it is by making you a peer that the Queen has shown her appreciation of all you have done for science and the world, and I look forward to many pleasant meetings when we shall be present together (perhaps even when returned from opposite lobbies !) on parliamentary duty."

Dr. Weir Mitchell, author, poet and physician, and above all a citizen of the United States, where empty titles are supposed to be held in low esteem, wrote in a more serious strain:

"I certainly never expected to be able to address a physician [1] as a peer of the realm. That you should have been chosen to add distinction to the peerage has given the utmost pleasure to many on this side of the ocean. Surely in all the great story of surgical progress there has been no one man who has given to his fellows a gift so great as that which came from your hand. It is a little thing —a title—but, if it represents to you the gratitude of the world, it

[1] That is a medical man.

acquires larger meaning than if it had been given even for service, however great, to your own country alone. It—that which you did—was a thing so past comparison great and far reaching, that, except as to our own gift of anaesthesia, there is nothing in medical annals with which to compare it.

Let me add my personal felicitations, and say how much pleasure it gives me to feel that our profession is at last receiving the long delayed recognition, the absence of which has for so many years surprised us.

I hope to live to see some physician win as well deserved a peerage."

A little note from Mme. Pasteur may perhaps also be given:

"Madame Pasteur prie Lord Lister de vouloir bien lui pardonner le retard involuntaire qu'elle a mis à le féliciter de son nouveau titre. Quelle joie eût éprouvée M. Pasteur de lui envoyer avec les siens ses plus affectueux compliments! Paris le 22. Janvier 1897."

Lister expressed his own feelings with regard to his peerage in the course of a short speech at Belfast on January 20th. Queen's College was celebrating a jubilee of its own by opening some new physiological and pathological laboratories, and made it, in true Irish fashion, the occasion for two days' festivities. After the opening ceremony by the Lord Lieutenant there took place what was called "a charming symposium" in Lister's honour in the "gruesome surroundings of the medical museum." His figure adorned the programme in the character of St. George clad in armour and wearing peer's robes, his foot planted upon a huge moribund dragon representing disease, which, in that land devoid of reptiles was described as a scorpion! His health was proposed in glowing words by his old pupil Professor Symington, and in reply he said that if he had known beforehand that he was to receive such a distinction as the peerage he should probably have declined it, unless possibly he could have ascertained before accepting it, that the members of his profession would have approved of it.

Next day there was a more solemn meeting and a congratulatory address,[1] in response to which he made a longer speech dealing with the importance of practical instruction in pathology, and with the harm to pathological research that would result from restricting it by meddlesome legislation.

[1] *Brit. Med. Journ.* 1897, vol. i. p. 317.

Nearly half of his speech was devoted to this subject. The controversy is now much less acute than it was in 1897, and the interest is therefore rather historical than present in such a passage as this :

" There are people who do not object to eating a mutton chop—people who do not even object to shooting a pheasant with the considerable chance that it may be only wounded and may have to die after lingering in pain, unable to obtain its proper nutriment—and yet who consider it something monstrous to introduce under the skin of a guinea-pig a little inoculation of some microbe to ascertain its action. These seem to me to be most inconsistent views. With regard to all matters with which we are concerned in this world, everything depends upon the motive. A murderer may cut a man's throat to kill him; any one of you medical students may have to cut a man's throat to save his life. The father who chastises his son for the sake of the good of his morals is a most humane man; a father who should beat his son for the mere sake of inflicting pain upon him would be an inhuman monster. And so it is with the necessary experiments upon lower animals. If they were made, as some people seem to assume, for the mere sport of the thing, they would be indeed to be deprecated and decried; but if they are made with the wholly noble object of not only increasing human knowledge, but also diminishing human suffering, then I hold that these investigations are deserving of all praise. Those little know, who lightly speak on these matters, how much self-denial is required in the prosecution of such researches when they are conducted, as indeed they always are, so far as I am aware, with the object of establishing new truth. The exercise of a little charity might lead those who speak of us as inhuman, to reflect that possibly we may be as humane as themselves. The profession to which I have the great honour to belong is, I firmly believe, on the average, the most humane of all professions. The medical student may be sometimes a rough diamond; but when he comes to have personal charge of patients, and to have the life and health of a fellow-creature depending upon his individual care, he becomes a changed man, and from that day forth his life becomes a constant exercise of beneficence. With that beneficence there is associated benevolence; and in that practical way our profession becomes the most benevolent of all. If our detractors knew this, common sense would enable them to see that our profession would not be unanimously in favour of these researches if they were the iniquitous things which they are sometimes represented to be."

After speaking of Pasteur's extreme sensibility, the exceedingly slight pain caused by operations sometimes described

as hideously painful, and the life-saving results in such diseases as diphtheria, he said:

"But it is by no means only in diphtheria that such an institute is likely to confer benefits of this kind. In the case of the streptococcus which is the cause of erysipelas and kindred disorders, including that very terrible disease, puerperal fever, there are very promising indications that the use of antitoxic serums will rescue patients from otherwise hopeless conditions. Let anyone picture to himself the case of a young wife after her first confinement afflicted with this dreadful puerperal fever, and doomed under ordinary treatment to certain death. The practitioner makes an injection of this serum under the skin, with the result that the lady rapidly recovers, and in a few days is perfectly well. Let any man conceive such a case as this, and all objections to the investigations necessary to bring about such a state of things must vanish into thin air. So soon as our poor selves are concerned our objections disappear. If a tiger threatened to attack a camp, who would care much about what kind of a trap was set for it, or what suffering the trap caused the animal, so long as it was caught? When the matter affects only the welfare of others, including generations yet unborn, the good done does not appeal to the individual, and the objector sees only the horrors of modern scientific investigation: of which horrors, however, he quickly loses the sense as soon as he becomes personally concerned."

There was a great banquet in the evening which Lister was unable to attend, because he had been called back to London, to take a prominent part in the initiation of the Prince of Wales's scheme for a hospital fund for London, now known as "King Edward's Hospital Fund for London."

He was present at the first meetings at Marlborough House when the project was discussed, and was the first chairman of the Distribution Committee, which office he held till 1902.[1]

When a man unaccustomed to political methods enters the House of Lords in his seventieth year, it is hardly to be expected that he will take much part in its debates. Twice

[1] The Report for 1903 commences thus: "The Committee desire to record the great loss they have sustained in the retirement of Lord Lister from his position as their chairman, the arduous and responsible duties of which he had so well performed since the Fund was founded. They desire to express their deep appreciation of the services he has rendered and their regret that his advancing years and the state of his health compelled him reluctantly to retire."

—but twice only—did Lister make important speeches. In both cases the course which he thought best was impracticable owing to the opposition which medical reform frequently excites in the over-scrupulous and over-conscientious. In both he was therefore obliged, with evident reluctance, to look at his subject from the point of view of the politician, and to accept the second best because the very best was not attainable.

The first occasion was in May 1897, when the subject of the incidence and effect of contagious diseases, or, in plainer words, of venereal diseases, in India was raised by a motion of Lord Dunraven in these general terms:

"That in view of the Report of the Departmental Committee of the India Office of the 20th day of Feb. 1897, it is in the opinion of this House urgently necessary that an Inquiry be made into the effect of such diseases upon the Forces of the Crown, the civil population, and the native races within Her Majesty's dominions, and into the nature and results of the measures which are, or have been, in force in this and other countries for the prevention of such diseases."

Some years had passed since the abolition of the Cantonment Act and the various Contagious Diseases Acts, owing to the pressure put upon the Government by powerful lay organizations, some of them of a religious character, supported by familiar arguments which it would be out of place to discuss here. It need only be said that they threw doubts upon the almost unanimous opinion of the military and medical authorities that the increase of venereal diseases which followed the withdrawal of the repressive Acts had been directly due to this action.

Meantime, the Secretary of State for India, Lord George Hamilton, had sent a despatch to the Government of India, who were endeavouring to frame some regulations in accordance with its instructions.

The question therefore before the House was whether it was advisable to spend further time in enquiry: whether the urgent need was not for action rather than enquiry, especially at this particular moment, when sufficient time had not yet elapsed to show what the effect of the dispatch of the Secretary of State would be.

Subjects of this nature, involving the health of the community, did not fail to attract Lister's attention even when his mind was most occupied with scientific work. He usually reached without difficulty a sound logical conclusion, which he then held without misgivings. He was impatient of inaccurate statements and loose arguments such as were often put forward by sentimentalists or enthusiasts. In this case he confirmed the opinion he had long held, by reference to documents and statistics and by a considerable correspondence, before making his maiden speech, which is said to have been delivered without nervousness, and to have been listened to with marked attention.

He approached this unsavoury subject from several points of view. He criticized the dispatch and said that it was hampered with restrictions which he feared would interfere with its utility. He doubted whether efficient regulations could be made in the face of these restrictions. But he thought it unwise to embark in new enquiry till the Government of India had framed its regulations. Moreover, he feared that further enquiry might appear, as in the case of the Vaccination Commission, to hold out the idea that the case was not sufficiently proved.

In these views he met with general support. But it was far otherwise when he went on to appeal for the uniform treatment of all contagious diseases—typhoid, diphtheria and the rest, and said that he had no objection in principle to the Contagious Diseases Act; that he thought it a most beneficent act and that he hoped, at no distant time, to see it re-enforced in this country. He concluded by saying, "I trust, whether the Inquiry be instituted or not, that this House will give distinct encouragement to the Government of India to persevere in the good and Christian course on which they have entered." There is no doubt that this was the general view of the medical profession in this country at that time, and by them, at least, his bold advocacy of it was cordially approved.

Lord Dunraven's motion was, by consent, withdrawn. But the matter was not allowed to drop, either in Parliament or out of doors, and Lister continued to exercise his influence

upon members of the Government in private. He was perhaps in consequence spared the necessity of moving a resolution of his own in the House of Lords, which at one time he feared might be his unpleasant duty.

The second occasion on which he intervened, was when the Vaccination Bill came up from the Commons in August 1898, with the much debated "Conscience Clause" inserted at the last moment.

England lagged behind other countries in adopting compulsory vaccination. It had only been in force since 1853. But it had been a failure owing to the persistent opposition of the passive resister, the conscientious objector, and the bigoted antivaccinator, largely supported by those who on general and sentimental grounds object to any legal compulsion of this description. These worthy people are the bugbears of politicians. Scientific facts and arguments of expediency do not appeal to them. But they may easily turn the scale at a general election in this country where the rights of the individual are too often held to be more sacred than the welfare of the community.

A Royal Commission, appointed in 1889, had taken no less than seven years to complete its labours. And now, two years later, the public was shocked to hear, after very serious outbreaks of smallpox at Gloucester and Middlesborough, that out of every 900,000 children born annually, only 600,000 were vaccinated. Deductions for death, migrations and other causes had no doubt to be made, but it was not denied that the real cause was the refusal of guardians to prosecute, and the fact that, if they did prosecute, magistrates could not be induced to impose repeated fines which, after all, failed in their purpose, and shocked the public conscience.

Under these circumstances the Government were obliged to take the matter up. The President of the Local Government Board, Mr. Henry Chaplin, brought in a Bill, containing many of the recommendations of the Commission, which removed most of the grievances, real or imaginary, of the objectors.

It provided,

1. That no person need submit to arm-to-arm vaccination; thus doing away with the risk of conveying other diseases to the vaccinated

person, which was a remote possibility when humanised lymph was employed.

2. That vaccination was to be domiciliary, and not at public offices ;—a great boon to the mothers.

3. That the age before which vaccination must be performed was to be extended from three to twelve months.[1]

But instead of introducing a complete "conscience clause," as the Commission had recommended, it simply abolished repeated penalties in the case of the conscientious objector. In future he would only be fined twice.

No mention was made of revaccination.

The Bill was to be experimental for five years.

At first it appeared to meet with general approval, though it was evident that the omission of the conscience clause would not go unchallenged. Prolonged and animated but somewhat confused debates followed, and at last, though under strong protest, the Bill was sent upstairs to a Grand Committee. It returned with a full-fledged conscience clause, the deletion of which was now demanded with as much vigour as its insertion had been pressed at the second reading.

Mr. Chaplin, however, was not to be moved. He made a long speech describing, rather plaintively, why the Bill had been introduced without a conscience clause, and how the clause had been forced upon him. He said it was useless to tell him that the medical profession were unanimous in opposition to it, seeing that all the five medical members who had spoken were in favour of it. In short, he made it clear that he meant to pass the Bill, which obviously the majority would not accept without the clause, and that therefore he refused to abandon it, although quite unconvinced as to its wisdom. And after all, he urged, five years would show the success or failure of the experiment.

Lord Harris had charge of the Bill in the Upper House, where he repeated the arguments of the President of the Local Government Board.

In the Committee stage, the Marquess of Aylesbury moved the rejection of the Bill. He objected that it had been chopped and changed about at the eleventh hour, and brought up

[1] This was afterwards reduced to six months.

at the fag end of the session as though the House of Lords were a mere registration society. He particularly disliked the conscience clause. He said the idea of making vaccination popular was absolute rubbish, and prophesied that, if it were passed, they would see a most fearful outbreak of smallpox of which they would have been unwittingly the cause.

The debate vied in length with those in the House of Commons. Lister voted with the Government in spite of the obnoxious clause, which he allowed might be beneficial if it led to more compulsion on the part of the guardians and diminished factious opposition. He explained how the Bill did away with the two principal complaints of the anti-vaccinators. "The antivaccinator has two weapons. One of these is the supposed possible dangers of vaccination, and the other is the martyrdom which it is thought is endured by persons who are subjected to fines and imprisonment for disobeying a law which, rightly or wrongly, they believe subjects their children to danger. Now, as regards the former of these weapons—the supposed dangers of vaccination—the glycerinated calf-lymph will remove it." [1] After explaining this in some detail he continued: "The second weapon of the antivaccinationist—namely the martyrdom of the honest objector—would, of course, be struck out of his hand at one stroke by the present bill."

He thus assumed the uncongenial rôle of the opportunist, for he saw that the deletion of the clause would stop all legislation for the time and leave matters in their then unsatisfactory condition. He regretted the absence of any attempt to enforce revaccination, though he allowed that, in the present temper of the House of Commons, it was useless to suggest its introduction. But he added that he had a confident hope, from what he had heard, that the Government would bring in a Bill dealing with revaccination in the course of the next session. This made him more readily acquiesce in what he confessed was a tremendous experiment.

However, in spite of a powerful speech from Lord Salisbury, the conscience clause was cut out by a majority of 2 (40 to 38). The Commons reinserted it by 129 votes to 34, and

[1] See page 527.

another long debate took place in the House of Lords, in which Lord Stanmore made an amusing reference to Lister's speech.

"Lord Lister, on the other hand, thinks that this would be the greater evil [namely, to lose the Bill rather than pass it with the conscience clause], but I venture to point out to your Lordships that his great fame and great reputation have been earned in a far nobler field than that of political struggles, and that on a question of practical politics we are justified in not ranking his opinion quite so highly as we should on a question of medical science. It is evident that Lord Lister's desire that the Bill should pass now was greatly prompted by the hope that next year the Government would bring in a Bill for compulsory revaccination of adults. He is led by a mere *ignis fatuus*; for anyone who has had practical experience of public life must be well aware that neither next year nor ever will any Government voluntarily introduce a measure certain to encounter such widespread opposition."

The politician has proved to be a better prophet than the guileless surgeon.

After this, Lord Salisbury made a wise speech. The clause was put back and the Bill agreed to.

The Vaccination Bill caused Lister great anxiety and he was much relieved when he found that the medical and lay journals agreed that he had taken the right course and that "even the Spectator had been converted." In a letter to his brother, August 8th, he says of this speech:

"I am rather afraid from what thee say that when thee read it again, thee will not altogether approve.

But it would have been a very serious thing to leave matters as they are, worse and worse year by year; the only alternative.

I have a letter to-day from Sir William Gairdner of Glasgow, who has been in his time a sanitary officer, expressing cordial approval. I can only hope that the good it will do will preponderate over the harm it may do. I was greatly perplexed as to the course I ought to take. The Lords have this afternoon adopted the 'conscience clause' as sent back by the Commons. Both sides were more numerous than on Thursday, five more on the side against the clause, and ten more on the Government side."

His only other speech in the House of Lords was a short one in favour of the Early Closing Bill in 1900.

CHAPTER XXXIII

CANADA. PUBLIC CEREMONIES. FREEDOM OF THE CITY OF EDINBURGH. THE VIRCHOW CEREMONIAL. LIVERPOOL. THE HUXLEY LECTURE

(1897-1900)

LISTER'S peerage was the subject of many congratulatory addresses, and was celebrated at dinners and public functions too numerous to mention. One of the most interesting was a banquet given in his honour by his old house-surgeons, clerks, and dressers, in May 1897. They had served under him at Glasgow, Edinburgh, and London, and now gathered from far and wide, to the number of 130. Many had already made their mark in medicine or in science. They felt a personal pride of their own in the unique distinction bestowed upon "the Chief," for few teachers have inspired such deep loyalty and affection. Their names, and those of many others who could not attend, were inscribed in the customary morocco-bound volume, and the enthusiasm was even greater than is usual on such occasions. But, for the guest in whose honour such a feast is given, the edge of the pleasure is blunted by a feeling of sadness; for he accepts the homage as a sign that his active life is almost over. It is no wonder, therefore, that there were obvious signs of emotion in the short and feeling speech in which Lister acknowledged the toast of his health.

In the autumn of 1897 both the British Association and the British Medical Association held their annual meetings in Canada, the former at Toronto and the latter at Montreal. Lister was present at both. At Toronto he received the

degree of LL.D.; at Montreal he was presented with an address at a dinner given in his honour by the Medico-Chirurgical Society.

When all these public ceremonies and festivities were over, a special railway car was put at the disposal of his party by Sir William Van Horne of the Canadian Pacific Railway; and in company with his brother and nieces, and Professor [1] and Mrs. Michael Foster he made a tour in the west which extended over three weeks. Several days were spent among the Rocky Mountains. Vancouver Island, the young towns of Vancouver, Seattle, and Tacoma, were visited, and a week was passed in driving through the Yellowstone Park. The journey was a round of hospitable entertainments involving short impromptu speeches, such as are expected even of less distinguished visitors to the Dominion. With such companions the study of new animals and plants afforded endless interests. It was a time of complete relaxation and thorough enjoyment.

The following summer (June 15th, 1898), he received the freedom of Edinburgh, in company with Lord Wolseley. It was rather a formidable occasion. The city was *en fête*. There was a military guard of honour. The great M'Ewan Hall was crowded. Lord Wolseley, in the full-dress uniform of the Commander-in-Chief, sat on the right hand of the Lord Provost in his magisterial robes, while Lister, in plain morning dress, sat on his left.

Lord Wolseley, in a soldierly speech, referred to his association in the field with many of Scotland's most historic regiments; and hoped "that Scotland may never fail to keep the ranks of her national regiments full, so that wherever the Union Jack flies in action, there the Scottish pibroch may be heard to cheer our Highlanders to victory."

Lister naturally referred to old associations with Edinburgh.

"Here I spent some of my best and happiest years. The enthusiastic students it was always a joy to me to teach; and with my colleagues in the University, and many other distinguished citizens

[1] The distinguished physiologist, afterwards Sir Michael Foster.

of Edinburgh, my relations were of the most cordial description. I also received from Edinburgh a gift which I cannot name, but which was to me a source of unspeakable blessing."

Then he compared the soldier and the surgeon, in words that might have shocked him in his serious student days; but he had travelled far since then :

" I feel that the honour I have received is much enhanced by the fact that it has been conferred, on the same day, on the illustrious head of the British Army. The work of a general of the very highest rank, like Lord Wolseley, has certain analogies to that of the ideal surgeon. For the cure of ills in the body-politic he performs operations—bloody, painful, dangerous. But he executes his task with the least possible expenditure of human life and of human suffering, and he addresses himself to his work in the spirit of self-denying, of self-sacrificing devotion. It is true that the analogy of the surgeon's work with that of the soldier is not so great as it was some years ago. When I entered on the study of surgery, every surgical operation was attended by terrible pain and fearful danger. Thanks to anaesthesia—in the promotion and diffusion of which, the illustrious citizen to whom you have referred, the late Sir James Simpson, took so large a share—the actual operative procedure is now, as a rule, painless ; and thanks to other advances in other directions, the suffering and the danger that formerly attended the after-treatment have been to a large extent swept away. You, my Lord Provost, have referred in most generous terms to the share I may have had in bringing about this latter result. I thank you from the bottom of my heart for your gracious words ; for I must confess that highly, and very highly, as I esteem the honour which you have conferred upon me, I regard that and all worldly distinctions as nothing in comparison with the hope that I may have been the means of reducing in some degree the sum of human misery. And if I am not presumptuous in indulging this hope, I share it with the humblest practitioner who discharges to the best of his ability the sacred duties of our noble profession."

Lister wrote to his brother the same day :

" The great ceremonial has passed off as well as could be expected. I had a few minutes in the greenhouse of the Botanic Garden on Monday for my speech, and thought of it somewhat on the journey yesterday. And this morning I finished my cogitations in the West Princes Street Gardens. What I said was certainly well received by the great audience, I suppose 2500. It is a relief to have it over."

The civic function was not the only one.

"Thursday was indeed a fatiguing time [he says in another letter]. Prof. Ewart drove me to Penicuick to see his zebra and other hybrids in the morning: I was just in time for lunch at 1.30 at my old friend David Christison's and from there I went with little interval to the reception at the College of Surgeons, where I had to shake hands with about 300 people, all medical men and their wives &c., many coming from distant parts. And lastly, I had scarcely more than time to dress before I had to go to preside at the dinner of the old Infirmary Residents, a very interesting gathering, some contemporaries, many old students and many of a younger generation."

He spent a few days with Sir Hector Cameron in the Trossachs before returning to London, where he immediately had to turn his attention to the knotty question of the Vaccination Bill.

After these strenuous times he felt the need for complete rest, which he sought in a solitary holiday in Wales. For the first time this year he began to speak of the exhaustion produced by his many public duties, and of his health not being as good as it used to be. A quiet time was also required in order to think over some important duties which were in prospect at the opening of the winter session.

A letter to his brother, dated September 12th, gives a picture of him in his secluded retreat. After describing how he happened to fix upon Llangammarch, and how its lovely country, its fine trout stream and noble hills reminded him of Moffat, he says:

"I felt rather in need of some real quiet: having been a little run down in London. Absence of appetite . . . the excessive heat, and, last not least, the real worry connected with the Vaccination Bill, had the undesired effect. And so this place suits me remarkably well. The 'Manageress' takes very good care of me in the way of meals, which I have snugly in my own room: and though of course there *is* companionship which would be most acceptable and delightful, yet the days pass only too quickly, without giving me time to read by any means all the interesting current literature I have at my disposal. The mere *Times*, which I get daily, occupies considerable time, being just now so remarkably full of interest of various kinds.

The deplorable revelations of what is going on among 'advanced' Church of England people I cannot but read. Then the successive detailed descriptions of that awful battle of Omdurman and what preceded and followed it, are tremendously interesting reading. And the accounts of the Bristol Meeting [of the British Association] come just now daily. Sir William Crookes's address is a most remarkable one. It would indeed be a signal instance of the practical value of abstract scientific research if the laboratory experiment of burning nitrogen by aid of the electric spark should lead in future generations to the rescuing of mankind from starvation.

Personally I cannot but regret his notions about 'telepathy'! He does indeed speak philosophically about the need of guarding against deception in various forms. But I fancy if he had physiological knowledge and knew more of the strange vagaries of nervous disorder, he would avoid sources of deception better than, I fear, he has done."

In another letter, two days later, he speaks of the primitive Welsh-speaking population, of pleasant walks by the river, of not very successful fishing, and of a gradual improvement in health, and then continues:

"They seem [to be] going to make a great fuss about my visit to Liverpool on Oct. 8th, as thee will see from the enclosed letter of the new Principal (Glazebrook). I had no idea when I consented some time since to open the new laboratories that there would be such a ceremony and such an attendance. . . . I am to stay again at Bickersteth's. Earlier in the month I am to take the principal part in the reception to be given to Virchow; and that will be no sinecure. I could have been well pleased to have been left in quiet for a bit longer."

The reception to Virchow was on the occasion of his delivery of the second of the Huxley lectures, which are given biennially at the Charing Cross Hospital. Of these, Michael Foster gave the first and Lister the third.

Virchow is one of the most notable figures in German history of the nineteenth century. His multifarious achievements are almost incredible. He was a prominent politician, at one time the leader of the Opposition in the Reichstag and a violent opponent of Bismarck. As an active member of the Municipal Council he was largely responsible for the sanitary reformation of Berlin. He was a high authority

on anthropology. He wrote books on the ruins of Troy, after accompanying Schliemann on some of his exploring expeditions. But above all, he was a pathologist: a pathologist who did not divorce the pure science from the study of clinical medicine. He has been called the father of modern pathology, chiefly because of his epoch-making lectures on "Die Cellularpathologie," delivered and published in 1858, which, as Lister said, "swept away the false and barren theory of a structureless blastema, and established the true and fertile doctrine that every morbid structure consists of cells which have been derived from pre-existing cells as a progeny." Some of its fruits were seen in Lister's earlier physiological and pathological work. Virchow was a genuine lover of England. He admired her liberal institutions, and he found in British medical literature much that was congenial to his own mode of thought. Glisson and Hunter, Huxley and Darwin received from him their meed of praise, and he held up John Goodsir especially as a model of keen and accurate observation. We, on our part, welcomed his frequent visits to this country, where he had countless admirers and many friends, amongst whom Lister was one. The Royal Society had made him a Fellow in 1884, had given him the Copley medal in 1892, and selected him as the Croonian Lecturer in the following year. Other learned Societies had united to do him honour. He was an honorary graduate of more than one University, and now in his seventy-seventh year it was proposed to celebrate the delivery of his Huxley lecture by giving him a specially hearty welcome.

Lister presided at the lecture, which was a striking review of the recent advances in science and their bearing on medicine and surgery. Towards its close, after referring to the antiseptic system, Virchow said: "The opening up of further regions of clinical medicine to the knife of the surgeon, and a perfect revolution in the basis of therapeutics, have been the consequence. Lord Lister, whom I am proud to be able to greet as an old friend, is already and always will be reckoned amongst the greatest benefactors of the human race."[1] At this, there was a great burst of applause, during

[1] *Brit. Med. Journ.* 1898, vol. ii. p. 1083.

which he turned from his desk with a sudden impulse, and grasped Lister's hand.[1]

After the lecture Virchow was entertained by the Staff of the Charing Cross Medical School. Next day there was a reception at the house of his old friend and former pupil, Sir Felix Semon, and on the following day a great banquet, at which Lister presided, when 220 representative men were gathered from all parts of the kingdom. It was a great occasion, accompanied by 'hochs' and cheers and general enthusiasm.

Scarcely were these festivities over when many of those who had taken part in them, including Virchow, met again in Liverpool to assist at the opening of the new Thompson-Yates laboratories for physiological and pathological research.

The history of the Liverpool medical school, like that of some others in provincial cities, excites the envy of Londoners. Liverpool is not too large for the existence of a true esprit de corps. Its inhabitants feel a personal interest in what was then its University College, and is now its University. Wealthy citizens could be counted on to found chairs and to raise buildings. And thus, after starting in a humble way in 1837, it had by 1898 become one of the best equipped medical schools in the country. The latest addition had been the erection and endowment of these fine laboratories by the Rev. S. A. Thompson-Yates. It was an interesting thing, as Professor Sherrington said at the ceremonial banquet, "that a devotee of the 'Queen of Sciences,' theology, should have done such noble service by his benefaction to branches of science, between which and theology there had been misunderstandings."

Two years before, Lister had been the honoured guest of Liverpool, when he was President of the British Association. The prospect of again seeing and hearing him apparently accounted in part for the extraordinarily large gathering on

[1] "Equally touching it was when, at a small dinner given by Virchow on the occasion of his 80th birthday to his family and a few intimate friends, he did such eloquent homage to the greatness of Lord Lister's work that the latter could hardly restrain his emotion." (Sir F. Semon, *Brit. Med. Journ.*, Sep. 13, 1902.)

this occasion. A Liverpool paper described it as "the stateliest and most picturesque ceremonial ever seen in Liverpool, and one of the finest ever seen anywhere." [1] Making due allowance for proper local pride, it must be allowed that it was an imposing spectacle. Lord Spencer, the Chancellor of the Victoria University, a noble figure, headed the long procession, mostly in academical robes, which took twenty minutes to pass. After Lister had received the degree of D.Sc., he made a speech much on the same lines as that which he had delivered in 1897 in Belfast, but more important, on account of the character of the audience. He insisted on the absolute necessity for practical demonstration, in addition to merely theoretical instruction; and for research both in physiology and pathology; dwelling on the rapid progress of these sciences in recent years, and the share they were taking in the elucidation and cure of disease. He then showed at some length the impossibility of carrying out such researches without the help of experiments on animals, and again exposed some of the fallacious statements and appealed to the reasonableness of those who thought this method of investigation altogether unjustifiable.

The speech was much applauded. It was freely commented upon, for the most part with approval, both in the medical and the lay press. But some doubted the wisdom of again stirring up a strife, which for the moment was not in its most acute stage, and dreaded a flood of fierce criticism.

In a letter to his brother (October 9th), he described the visit, and the usual hurry at the last moment.

"Thee perhaps will have seen from the *Times* that my task was accomplished after a fashion yesterday; though it was a great drive preparing for it.

The Virchow entertainments in London had prevented me from getting on as I had expected: and it was only on Friday morning that, in the Botanic garden, I wrote down in pencil in a note-book the earlier part of my speech. The rest was written yesterday morning; and the concluding part was only scribbled in the last half hour before I had to go to the Ceremony in St. George's Hall.

An immense assemblage was gathered there, estimated at 4000. Yet I am told I was heard by all. Nothing could exceed the warmth

[1] *Liverpool Post*, October 10th, 1898.

of my reception; the whole mighty company rising when I went forward to receive my degree at Lord Spencer's hands.

There was no indication of anything but approval of what I said on the delicate subject of experiments on animals.

In the evening the Lord Mayor gave a dinner to nearly 150 men of distinction who had come from various quarters, including Dublin and Belfast, to take part in these proceedings.

I am now just going to an afternoon 'at home' given by Prof. and Mrs. Herdman."

These public duties and ceremonies, and many others of a like description, made Lister's life still very busy. But they were far less exacting, and of much less general interest than the pursuits of his active middle life. In the intervals he was much occupied with the work of the Royal Society and the Jenner Institute, which forced him to spend much time in making himself familiar with the work of others in the ever-widening field of bacteriology, especially in that part of it which relates to public health, sleeping sickness, malaria, the cattle plague, tuberculosis and diphtheria. Chiefly as a result of this, his own investigations were laid aside. His spare time was spent in his study poring over monographs and official documents. The inner sanctum was deserted, and dust began to accumulate upon hot-boxes, flasks and test-tubes. Between 1896 and 1899 there are no notes in the "common place book," and then there comes the last, rather pathetic entry: "21st July 1899. At length, after three years I am taking steps to ascertain the degree of antimicrobic property possessed by the chromic and tartaric gut prepared for the purpose." But the tests were to be made at the Jenner Institute, not by himself, and the results were never recorded.

The extent to which he kept himself abreast of the knowledge of the day is shown in his last address as retiring President of the Royal Society in November 1900,[1] commenting on which one of the Medical Journals speaks of him as the "venerated and venerable apostle of antiseptic surgery," and says, "But this remarkable address . . . shows that his genius has not been trammelled nor his sympathy narrowed

[1] See page 528.

by preoccupation in one particular line of work. It shows him ripe in experience and judgment, youthful and sympathetic in the comprehension and appreciation of new ideas." [1]

A few days before the delivery of this address he had given, in the "Third Huxley Lecture," [2] a complete summary and history of such of his earlier physiological and pathological work as bore "more or less directly upon the antiseptic system of surgery." It was the last of his great public addresses.

Starting with his student days, he described the attraction of Sharpey's lectures, and the eagerness with which he used his father's gift of a first-rate microscope for verifying what he had been taught. He told how amongst his very earliest records of such work were notes which showed that, even then, he was specially attracted by the appearances met with in pyaemia and hospital gangrene, and how he discovered and drew with the camera lucida strange large cells in the pus of pyaemia; and how, in the hope of discovering the nature of the poison in hospital gangrene, he examined microscopically the slough and pus from one of the sores, and having found some bodies of pretty uniform size, imagined that they might be the *materies morbi* in the shape of some kind of fungus. "Thus," he said, "as regards that form of hospital disease, the idea that it was probably of parasitic nature was at that early period already present to my mind."

Then he passed on to his life in Edinburgh, where "the very liberal regulations of the University and the College of Surgeons," enabled him on the expiry of his house-surgeoncy at the Royal Infirmary, "to start a course of lectures on surgery qualifying for the examinations of both bodies." He said that the uncertainty existing at that time with regard to the process of imflammation, the very first subject he would have to teach, induced him to study the matter carefully for himself.

He described in some detail his investigations into the early stages of inflammation, and showed how this naturally passed by almost imperceptible stages into that of the coagula-

[1] *Brit. Med. Journ.* 1900, vol. ii. p. 1652.

[2] *Brit. Med. Journ.* 1900, vol. ii. p. 969; *Collected Papers*, vol. ii. p. 515.

tion of the blood; and how he was led, in both instances, to the differentiation of the effects of direct injury to the tissues from those induced upon them through the influence of the nervous system.

From Edinburgh the scene was shifted to Glasgow, where, he said, "I had too ample opportunity for studying hospital diseases, of which the most fearful was pyaemia." He explained how, under the circumstances, the most obvious step to take, closely connected with those that had preceded it, was the investigation of suppuration, and especially suppuration of a blood clot.

He had already been speaking for a long time, and it was impossible to enter into details as he had hoped to have done regarding these researches. This is unfortunate, as they were never published and his notes of them are not such as could, with advantage, be published now.[1]

"I must content myself," he said, "with stating the conclusion to which I was led at the time I am speaking of, and which was confirmed by later investigation, viz. that the introduction of septic material into a vein may give rise to the rapid development of large nucleated cells which, growing at the expense of the original constituents of the coagulum, convert it entirely into a thick yellow liquid. The pus so formed contains corpuscles which, like those which I sketched in the early case at University College, are not pus corpuscles in the ordinary sense or leucocytes, but the variously sized, more or less granular nuclei of the large cells, the pellucid bodies of which constitute the so-called liquor puris. Into the question of the origin of these rapidly proliferating cells I must not enter. This process of genuine suppuration of the blood-clot removed all the difficulties I had felt in interpreting the post mortem appearances in pyaemia, and also its clinical features."[2]

These views with regard to the suppuration of blood-clot he held with great tenacity. But they were not then, and indeed are not now, generally accepted, possibly because the observations on which they were founded were never published in detail. He continued:

"I am, of course, aware of the great importance of the emigration of leucocytes, discovered by Cohnheim, and rendered immeasurably

[1] For a fuller account of these notes see Appendix.

[2] *Collected Papers*, vol. ii. p. 541.

more interesting by Metchnikoff's observation of their phagocytic powers; and I know that collections of pus have often such an origin. But I am quite satisfied that this is not the exclusive mode of pus-formation, and that it is often produced by the proliferation of cells, as was first taught by my illustrious predecessor in this chair of two years ago (Professor Virchow), in the *Cellular Pathologie*."

Then he told how, while these investigations into the nature of pyaemia were in progress, he was " doing his utmost against that deadly scourge," by the fruitless administration internally of sulphite of potash as recommended by Professor Polli of Milan; and he concluded with these words:

" At the same time, I did my best by local measures to diminish the risk of communicating contagion from one wound to another. I freely used antiseptic washes, and I had on the tables of my wards piles of clean towels to be used for drying my hands and those of my assistants after washing them, as I insisted should be invariably done in passing from one dressing to another. But all my efforts proved abortive, as I could hardly wonder when I believed, with chemists generally, that putrefaction was caused by the oxygen of the air.

It will thus be seen that I was prepared to welcome Pasteur's demonstration that putrefaction, like other true fermentations, is caused by microbes growing in the putrescible substance. Thus was presented a new problem: not to exclude oxygen from wounds, which was impossible, but to protect them from the living causes of decomposition by means which should disturb the tissues as little as is consistent with the attainment of the essential object.

It has been since shown that putrefaction, though a most serious cause of mischief in wounds, is not its only cause. In other words, it has been proved that there are microbes which produce septic effects without occasioning unpleasant smell. But the principle that first guided me, still retains, I believe, its full value, and the endeavour to apply that principle so as to ensure the greatest safety with the least attendant disadvantage has been my chief life-work."

It cannot be said that no new facts were brought forward in this lecture, for a few hitherto unpublished observations and experiments were put on record. But for the most part it was a key to, or an explanation of, the system on which his life-work had been conducted. It might be called an *apologia pro vitâ suâ*, only he needed no speech in defence, as the verdict had long before been given in his favour.

CHAPTER XXXIV

THE SECOND TUBERCULOSIS CONGRESS
(1901)

THE French speak of *le premier coup d'âge*, followed at varying intervals by others leading up to the final stroke of Time's sickle. The downhill of life, they say, is not one continuous descent; but the pathway leads at times peacefully through level country and then without warning drops down sheer cliffs or steep declivities. One such decline in Lister's life happened to correspond with the date of the Huxley lecture and the end of the Presidency of the Royal Society. When the time for living at high pressure came to an end, he became aware that old age had been creeping on almost unobserved and that he had lost much of his old physical vigour and power of endurance.

It must not be supposed that his mental power was diminished, nor that his energy was abated. And he had always plenty to occupy his mind. He was still actively engaged with the affairs of the Royal Society and the Lister Institute; and there were many other more or less congenial public duties from which it was impossible to escape. There was also in near prospect another International Congress in which he was destined to play an important part.

This was the second Tuberculosis Congress. It was held in London in July 1901, and proved to be one of the most noteworthy and perhaps the most fruitful of the special congresses of recent times.

Lister had unfortunately, in the course of his life, often been obliged to think of tuberculosis not only from the

scientific, but from the personal point of view. One of these occasions was in 1890, about the time when Koch first announced the discovery of tuberculin, and, over-persuaded by his friends, but against his better judgment, gave directions for its employment therapeutically before its effects on patients suffering from tuberculosis had been thoroughly tested. All the world hailed it as a panacea, and thought, or hoped, that tubercle would soon be at least as much a thing of the past as leprosy. Tuberculin was extensively used for treating all sorts of tuberculous affections, and with startling results. Many patients, after a preliminary reaction, which was sometimes very severe, improved in an extraordinary manner, though often only for a time. Not infrequently, however, the reaction led to disaster.

Soon after the appearance of Koch's paper, a young niece of Lister's was quickly passing, if she had not already passed, into the hopeless stage of a rapid decline. He took her to Berlin and watched from day to day, with keen but painful interest, the treatment carried out, under Koch's supervision; but the result was, as later experience has shown to be the rule in such cases, a bitter disappointment.

By 1901 the rage for the promiscuous use of tuberculin had long since subsided; but it was known that Koch was to attend the Congress and that he had been continuing his investigations on tuberculosis. There was therefore much speculation as to the nature and importance of the new facts which it was understood he was likely to bring forward.

The preparations for the meeting were interrupted by the death of Queen Victoria in February 1901. Let us here turn aside for a moment to recall Lister's speech in moving the adoption of a loyal address of sympathy and homage to King Edward VII. from the Royal Medical and Chirurgical Society of London. He had a sturdy belief in the British Constitution, and private as well as public reasons for the veneration in which he held the Queen. The words that he used were therefore no empty phrases. Indeed, he

never used empty phrases. In the course of the speech, he said :

" The Medical Profession, whose object is to prevent or relieve the physical ills of mankind, appealed always to Her Majesty's warm and sympathetic heart, and, if it were suitable to speak of loyalty of a Sovereign to subjects, truly we might say that the Medical Profession never had a more loyal friend than it had in Queen Victoria. Those of her medical officers who have been privileged to attend upon Her Majesty would speak with one voice to this effect if they were all alive to this day. . . . I believe that I happen to be the only person who ever exercised upon her sacred body the divine art of surgery. The occasion was a most critical and anxious one, but, while she treated me with queenly dignity, nothing could exceed her kindness. We, then, the Medical Profession, feel, perhaps more than others, the greatness of the loss which we have sustained."

King Edward, as Prince of Wales, had taken great interest in the Congress and had accepted the Presidency, but as it was no longer possible for him to act in this capacity, his place was taken by the Duke of Cambridge. The gathering was a very large one, for in all parts of the world the medical profession and the public were becoming thoroughly aroused to the necessity of devising practical means for combating the ravages of tuberculosis.

Our interest in the Congress is concentrated on one special part of Koch's address.[1] He dealt with the whole subject: the methods of infection, the dangers of overcrowding, the need for special hospitals, the vexed question of notification, disinfection, education of the public, and sanatoria. But his views about all these matters attracted small attention in comparison with his unexpected declaration that he considered *bovine* and *human* tuberculosis to be two separate and distinct diseases, and that there was practically no danger of the infection of human beings from milk, butter, or meat, derived from tuberculous cattle. " This manner of infection," he said (meaning the transmission of the germs of the disease from bovine animals to man), " is generally regarded nowadays as proved, and as so frequent that it is even looked upon by not a few as the most important; and

[1] *Brit. Med. Journ.* 1901, vol. ii. p. 189.

the most rigorous measures are demanded against it. . . . Now, as my investigations have led me to form an opinion deviating from that which is generally accepted, I beg your permission, in consideration of the great importance of this question, to discuss it a little more thoroughly."

It would lead us too far to enter in detail into the experiments on which his opinion was founded. They were numerous and were made with rigorous exactitude. They seemed to prove the difficulty, indeed the impossibility of infecting cattle or even pigs by feeding or inoculating them with material rich in living tubercle bacteria of the human type. He dwelt on the absence of actual proof that human beings were ever infected with tubercle bacilli of the bovine type. He made much of the fact that, though children as well as adults were, at that time, constantly swallowing the bacilli of bovine tuberculosis, tuberculous ulceration of the intestines was rare; and he maintained that unless there were such a primary lesion, the bacilli could not find their way into the system from the intestines.

Avian tubercle, that is the tubercle of fowls, he agreed with other observers might be neglected.

But though he spoke strongly, he spoke with caution. "Considering all these facts, I feel justified in maintaining that human tuberculosis differs from bovine, and cannot be transmitted to cattle. It seems to me very desirable, however, that these experiments should be repeated elsewhere, in order that all doubt as to the correctness of my assertion may be removed." He added that the German Government had appointed a Commission to make further enquiries into the subject.

This was a bolt from the blue. Doctors asserted, and everyone believed, that one of the common and fatal tuberculous diseases of childhood, then known as tabes mesenterica, was caused by drinking the milk of tuberculous cows. In this affection the abdominal lymphatic glands are involved, but there is seldom ulceration of the alimentary canal. It was well known that the milk of many tuberculous cows contained tubercle bacilli; milk is a staple food of children, in whom this particular form of the disease is at least as

common, some say far more common, than primary consumption of the lungs. The chain of evidence, that the milk of tuberculous cows caused tabes mesenterica, seemed therefore to be almost complete. Pathologists had not troubled themselves about the absence of ulceration of the intestines, the particular link—if it were a link—in the chain, which appeared of such vital importance to Koch; and they had loudly proclaimed the necessity of sterilizing milk, testing dairy herds and slaughtering tuberculous cattle. The Local Government Board was on the alert, and farmers and dairymen were putting their houses in order under the eyes of municipal or Government inspectors.[1]

If all that Koch said was true, these tests and precautions were almost useless. If, on the other hand, his conclusions were unfounded, the relaxation of troublesome and costly restrictions, which would be sure to follow such a pronouncement from the greatest living authority, would lead to disaster.

Much was known at the time about the nature and habits of tubercle bacilli, but far less than is known to-day. A short statement of present views may help to explain the situation.

Tubercle affects many animals and produces in them similar though not identical results. Wherever tuberculous disease occurs, tubercle bacilli are found which, under the microscope, do not present greater variations in shape and size than are commonly met with in other well-defined species of bacteria. But though they are all so much alike, it is shown, by the effects which they produce on culture media and in animals, that they fall into three main groups, the human, the bovine, and the avian, and that these three

[1] The main powers of dealing with tuberculous meat are contained in Sections 116 and 117 of the Public Health Act of 1875, outside London; for London there are corresponding clauses in the London Act. These clauses give the sanitary officials power to seize, and a Justice power to destroy diseased meat. The general regulations with regard to milk are contained in the Dairies, Cowsheds and Milkshops Order of 1885 of the Local Government Board. In March 1899, that is not very long before the meeting of the Tuberculosis Congress, the Local Government Board had issued an order extending the definition of the disease in the case of a cow, to "such disease of the udder as shall be certified by a veterinary surgeon to be tuberculous."

varieties are the ordinary causes of tuberculous disease as it occurs naturally in human beings, cattle, and birds. There are also met with in some other diseases, such as lupus, bacilli closely resembling those of tubercle which do not precisely agree with any one of the three principal types.

At that time the three main types had not been so clearly distinguished from one another that it was possible to say of any particular strain obtained from a human subject, "This is bovine tubercle because it affects culture media and animals in such and such a way," or "This is human tubercle because it affects them in quite a different manner."

It is a question of paramount importance whether they are all the same organism modified by its environment, and so possibly convertible one into the other, or whether they are more or less closely related descendants of the same ancient stock which have acquired distinct characters by long association with the animals they infect. It is the same problem, long so hotly discussed, as that of the relationship between man and the anthropoid apes. Was man an improved gorilla or were they both distantly related descendants of a common ancestor living in a remote geological period? In the former case the descendants of our hairy cousins might possibly attain to be men, in the latter such a contingency is so unlikely as to be hardly conceivable.

Such speculations have not merely an academic interest. For on them hinges the question whether the three diseases are varieties of the same disease, and whether it is likely that bovine or avian tuberculosis will produce human tuberculosis, and that human tuberculosis can be transmitted to cattle and birds.

As a matter of fact, we now know that it is very difficult to infect cattle or birds with human tubercle; that it is easy to infect pigs with bovine and avian tubercle and not difficult to infect them with human tubercle; that avian tubercle is never met with in man, but that bovine tubercle is undoubtedly found in a considerable number of cases of human tuberculosis.

This last is the all-important fact which has been established by later observations. Koch denied it.

Lister, who was in the chair on this occasion, had introduced Koch to the meeting, and it fell to him to make some remarks at the end of the address. It is not known whether he was more prepared than the rest of the audience for Koch's unexpected announcement, but from what he wrote afterwards it appears that he also was taken by surprise. He instantly grasped its importance, and, while allowing the apparently convincing character of Koch's proofs, he at once pointed out some flaws in the arguments and pleaded for further investigation before action was taken upon them.

The summary of his speech and the letter which he afterwards addressed to the *British Medical Journal* are of such interest that they must be given in full. They are interesting not only on account of their matter, but as showing how completely wide awake he was at this time to the intricacies of this complicated problem. They show how competent he still was to enter the lists with so formidable an antagonist as Koch. They are, moreover, the last of his published contributions to bacteriology.

" Lord Lister said the discourse they had listened to was full of profound interest from the beginning to the end. But what had chiefly riveted their attention had been the startling thesis that bovine tubercle could not develop in the human body. This was a matter of enormous practical importance, because, if this conclusion were sound, it would greatly simplify their preventive measures; but it would be a very serious and grievous thing if the rules now in force for securing purity of milk supply should be relaxed and it should turn out after all that the conclusion was erroneous. For his own part he thought the evidence adduced by Dr. Koch to show that human tubercle could not be communicated to bovine animals very conclusive. At the same time he agreed with him that in a matter of such great importance further enquiry was desirable. But even if that were established it would by no means necessarily follow that bovine tubercle could not be communicated to man. He took in illustration the case of variola. Attempts to inoculate human small-pox into the calf had been so very rarely successful that eminent pathologists had concluded that small-pox and cow-pox were two

entirely different diseases. We now knew that this was an entire mistake; that cow-pox was small-pox modified by passing through the cow. He referred to some very instructive experiments by Dr. Monckton Copeman, who entirely failed to inoculate human small-pox into the calf but invariably succeeded in inoculating it into the monkey, and was as invariably successful when he introduced matter from the pustules in the monkey into the calf, the result being ordinary cow-pox which could be used for vaccinating children. It might be that some species of animal might serve as an intermediary host for tubercle between man and the bovine species. Or it might turn out that, if a sufficient number of experiments were made, human tubercle might prove occasionally transmissible to the bovine animal, as small-pox was in rare instances to the calf, and that the bovine tubercle so produced might be transmissible to man, as was the virus of vaccine. The evidence, necessarily indirect, on which Koch relied as showing that bovine tubercle could not be transmitted to man did not seem at all conclusive. It consisted in the alleged rarity of primary tuberculous intestinal lesions in children, in spite of the multitudes of tubercle bacilli swallowed by them in milk. Even if it were admitted that primary tuberculous intestinal lesions are as rare in children as Koch's statistics indicated, it was certainly true that tabes mesenterica existed in a considerable percentage of children who died of tuberculous disease, without tubercle being found in any other part of the body. When the mesenteric glands were thus affected without any discoverable intestinal lesion, the natural, and, indeed, inevitable, interpretation seemed to him to be that the tubercle bacilli had passed from the aliment through the intestinal mucous membrane without causing obvious lesion in it, and had been arrested in the glands of the mesentery. It was known that even typhoid bacilli, whose essential place of development was the intestinal mucous membrane, occasionally passed through it without producing the characteristic lesion. And if this might occur with the typhoid bacilli, how much more likely was such an occurrence with tubercle bacilli? If this were so, Koch's argument fell to the ground. As regards the experiments Koch had referred

to of inoculating bovine animals with material from the glands of children affected with tabes mesenterica, the result being negative,—these experiments had been but few; and even were they more numerous, they would not, to his mind, be quite conclusive. It might be that tubercle from milk in the intestines might be so modified by passing through the human subject that the bacilli in the mesenteric glands, though derived from a bovine animal, might be no longer those of true bovine tubercle but bacilli having the characters of human tubercle little disposed to develop in cattle. The Congress would probably require a more searching inquiry into the subject before accepting this doctrine of the immunity of man to bovine tubercle." [1]

On thinking over the report of his speech he concluded that it required some further explanation and, in one respect, correction. He therefore followed it up with a letter to the *British Medical Journal.*

"My remarks after Koch's address at the Tuberculosis Congress last Tuesday were made at very short notice, and the summary of them which you kindly published on Saturday was written very hurriedly, and there is one point of considerable importance in the latter which I should be glad, with your permission, to correct.

I stated that when the mesenteric glands are found affected with tubercle, without any discoverable intestinal lesion, in children that have died of tubercular disease, and no tubercle is met with in other parts of the body, the natural, and, indeed, inevitable conclusion seemed to me to be that 'the tubercle bacilli had passed from the aliment through the intestinal mucous membrane without causing obvious lesion in it and had been arrested by the mesenteric glands.' If for 'the aliment' I substitute *the alimentary canal* I express what I believe to be the true state of the case.

The intestinal contents consist, of course, not only of the food more or less altered, but also of the secretions of the various glands which pour their products into the alimentary canal. One such product is the bronchial mucus which, together with the dust of the inhaled air, is brought up by the cilia to the orifice of the larynx and perpetually swallowed unconsciously. The inhaled dust thus enters as truly into the composition of the intestinal contents as does the food; and in the case of a child fed on unboiled milk from a cow with a tuberculous udder in a room infected with tubercle,

[1] *Brit. Med. Journ.* 1901, vol. ii. p. 206.

it might be fairly open to question whether the bacilli of bovine tubercle imbibed at its meals or those of human tubercle derived indirectly from the inhaled air were the more numerous in its intestine. Hence the fact of the mesenteric glands being the only seat of tubercle in a milk-fed child is no proof that the bacilli which they contain were derived from the milk. This consideration may seem in favour of Koch's hypothesis; but it, in truth, deprives his argument based on the rarity of primary tubercular intestinal lesions in the child, in spite of the multitudes of bovine tubercle bacilli swallowed in milk, of any relevancy whatever; because, considering the extremely numerous bacilli of human tubercle often present in the intestinal contents, the argument might be used with equal force against the possibility of communicating human tubercle to man.

The truth appears to be that the intestinal mucous membrane is by no means a favourable site for the development of tubercle bacilli. This is manifest if we consider that, according to the experience of pathologists, only about two-thirds of the bodies of those who have died of pulmonary tuberculosis have tubercular lesions of the intestines. Or, to put it otherwise, the intestines of one-third of such patients have resisted the invasion of tubercle bacilli passed through them for months, or it may be for years, in enormous numbers in the swallowed expectoration. In the child the intestinal mucous membrane seems to allow the bacilli to pass through it more readily than in the adult; but, even in the young child, pathologists seem agreed that pulmonary tubercle is much more common than tabes mesenterica, although, as we have seen, the infecting dust passes through the intestine after its inhalation into the lungs.

Dr. Koch has shown that human tubercle is very rarely, if ever, transmissible to the bovine species. But of the converse proposition, incomparably the more important, that bovine tubercle is not communicable to man, there is, I venture to think, no reliable evidence." [1]

At its last session the Congress passed eleven resolutions, recommending most of the measures which, either before or since that time, have been adopted for combating tuberculosis. Amongst them was one for the appointment of a Royal Commission, which was promptly accepted by the Government. Its final report was issued in 1911.

All this is public property, but it is not generally known that Lister took a keen personal interest in the earlier part of the practical and experimental work of the Royal Commission.

[1] *Brit. Med. Journ.* 1901, vol. ii. p. 283.

He also initiated on his own account two series of experiments which were conducted by members of the staff of the Lister Institute (as it was now called). The object of the first series, carried out, according to the typewritten report found amongst his papers, "at the suggestion and under the guidance of Lord Lister," was to test Koch's views as to the essential difference between the human and bovine bacillus. It was to ascertain whether "differing results might follow under slight modification of the experimental conditions." The animal employed was the pig, and the results of experiments which were made on six animals were widely different from those of Koch, who had employed two animals only. "The six animals were all successfully infected with the human bacillus, and the character of the infection was at least as severe as that described by Professor Koch as the result of inoculation with the bovine bacillus."

The second series is thus described in a similar report, dated August 29th, 1902: "The main object of these experiments, which were carried out at Lord Lister's suggestion and under his direction, was to ascertain whether the tubercle bacillus of human origin undergoes any marked change in virulence for the bovine species by passage through certain other animals."

The animals employed were the pig, cat, rabbit, rat and mouse. No increase of virulence was observed, but incidentally it was shown that the human tubercle bacillus was by no means so innocuous to the calf as Koch had asserted.

It is evident that although Lister was now in his seventy-fifth year, he showed little sign of the waning faculties of advancing years; but he was nevertheless sorely troubled by the irksome accompaniments of old age. They were not such as could easily be overlooked or forgotten; and he often sighed, as his father had done before him, "Multa senem circumveniunt incommoda." A knee strained in early days had on many occasions been a cause of anxiety to him; for, blessed as he was, for the most part, with robust health, any slight illness was treated with perhaps more respect than it deserved. Now it was almost always painful, and he

suffered a good deal from rheumatism, or perhaps it was gout, and other troublesome ailments. He and Miss Syme were frequent visitors to Buxton, from the air or the waters of which he benefited, and where he enjoyed the devoted attention of the late Dr. Lorimer, a former pupil of Syme's, to whom he became much attached.

Walking became an effort. Still, he seldom missed his daily stroll in the Botanical Society's or the Regent's Park gardens. But he spent longer in his study; longer in his armchair with the *Times*, and gradually saw less and less of his fellowmen, till they began to ask what had become of Lister, and to speak of him as of one whose day was over.

CHAPTER XXXV

DECLINING YEARS. SOUTH AFRICA. EIGHTIETH BIRTHDAY. THE COLLECTED PAPERS. FREEDOM OF THE CITY OF LONDON AND THE CITY OF GLASGOW (1901-1908)

In the winter of 1901-2 Lister was recommended to take a voyage to South Africa, then passing through the last stages of the Boer War. On this expedition he was accompanied by one of his nieces and his faithful butler, Henry Jones, who had been with him in Edinburgh and London, and in the same capacity with his father in his declining years. They started in March, and after a few days Lister began to throw off his invalid habits, and to enter with interest into the small excitements of life on board ship. He succeeded, where so many fail, in making even a sea voyage a time for self-improvement. The days were regularly portioned out, with readings at stated times, from the Spanish New Testament, Dante's *Purgatorio*, the *Odes of Horace*, and pages from some English book. He keenly enjoyed two days at St. Helena, visiting the Governor's residence, the Boer Camp, and the scenes of Napoleon's exile. From Cape Town he made excursions to Groote Schoor, Simon's Town and other places round Camps Bay, greatly delighting in the Cape flowers, which, *more suo*, he collected, traced down, pressed and preserved. He did not feel equal to social engagements, but would talk eagerly with casual acquaintances, and followed closely the stirring events of the time,—the closing scenes of the war, and the impressive ceremonies of the funeral of Cecil Rhodes.

The homeward voyage was longer and the heat of the

tropics distressing. But, in spite of rheumatism, he did not spare himself if he thought he could give pleasure to others, distributing the prizes after the ship's sports and taking part in similar small functions from which he might well have held himself excused.

Thus passed not unpleasantly the last of Lister's journeys, ending on June 1st, 1902, the day before Peace was declared.

The change had done him good, but he was by no means well, and spent much of this year and the next at Buxton. Now and then he appeared again upon the scene, to perform some public duty or to receive some belated honour.

Before leaving London for Buxton, his advice was sought in connection with the serious illness of King Edward VII., which occurred a few days before that fixed for the Coronation ceremony. Lister, who was Sergeant Surgeon to the King,[1] was present at the consultation on June 24th, preceding the operation by Sir Frederick Treves, which saved his Sovereign's life, and was followed by the postponement of the ceremony for which enormous preparations had been made.

On the occasion of his Coronation the King instituted a new Order, the Order of Merit, limited to twenty-four, and designed, in the words of the Court Circular, as a special distinction to men eminent in any department whatever,—war, science, literature or art. Lister was one of the first members, of whom only twelve were appointed at this time.[2] It was also directed that he should be sworn a Member of the Privy Council.

On August 7th he wrote to his brother:

"I had felt doubts whether I should come up for the Coronation ceremony; but as I was steadily gaining strength, I felt it would be right that I should do so. I have come a day earlier than I had intended in consequence of a request (command) to attend at Buckingham Palace to-morrow afternoon, when the King will

[1] He had been appointed Sergeant Surgeon to Queen Victoria in 1900 on the death of Sir James Paget.

[2] The original twelve members of the Order of Merit were: Earl Roberts, Viscount Wolseley, Viscount Kitchener, Sir Henry Keppel, Sir Edward Seymour, Lord Lister, Lord Rayleigh, Lord Kelvin, John Morley, W. E. H. Lecky, G. F. Watts, Sir William Huggins.

confer the Order of Merit. I have also been summoned to a Meeting of the Privy Council on Monday at 12.30, when the King will admit the new members of the Privy Council. . . . We propose to return to Buxton on Tuesday afternoon. . . Had I been in my usual health I should have proposed going to you to spend Sunday, if that had been convenient to you. But I am still but a poor creature, and it would have been essential for me to return on Sunday evening; and that is an arrangement that never suits me very well."

He was in London again in November to receive the Copley medal of the Royal Society, a great honour, as it is awarded without restrictions as to nationality, or department of science, or the time at which the work may have been done for which the award is made. At the anniversary dinner, he returned thanks on behalf of the Medallists and ended his speech by saying rather pathetically that "he had often thought that if he did deserve any credit, it was at the time when, perfectly convinced of the truth of the principle on which he acted, and persuaded also of the enormous importance to mankind of being able to carry out that principle in practice, he worked for years together with exceedingly little encouragement from his professional brethren. There were, however, two great exceptions, his father-in-law and his students." He was thinking, no doubt, of the early Glasgow days before his fame had spread into foreign countries.

December 9th of this year was the fiftieth anniversary of the day on which Lister obtained the Fellowship of the Royal College of Surgeons. The Council of the College took no action in the matter, but the occasion was seized for congratulatory letters and laudatory articles in the press. The *British Medical Journal* brought out a "Lister Number," something after the fashion of a German *Festschrift*. It is an interesting production, though many of the articles deal with subjects that have little or no relation to Lister's work. Amongst the contributors were men who had fought the battle of antisepsis either as direct adherents or as close allies: von Bergmann, Lucas-Championnière, Durante, Bloch, Mikulicz, Ogston, Hector Cameron, John Chiene and Watson Cheyne.

It includes a bibliography of his writings and a long editorial summary of the effects of his work on modern medicine as well as surgery.

Another recognition of this Jubilee came from Denmark, where Lister's name had always been held in honour since the pioneering days of his old friend Professor Saxtorph. The King of Denmark now made him a Knight of the Grand Cross of the Order of the Dannebrog, which gave him perhaps more pleasure than any other of his later honours. The King and the Crown Prince seem to have been keenly appreciative of his work. Two years later, when a Tuberculosis Congress was held in Copenhagen, the rumour spread that Lister was actually on his way to attend it. The Crown Prince hoped that if this were true, he would be his guest at the palace, and sent him a gracious message to which, though then very feeble, Lister sent a long reply written with his own hand.

Christmas 1902 was spent at Lyme as usual, but it was for the last time. His rheumatism was very troublesome, in fact occasionally it crippled him altogether. So he and Miss Syme went to Bath and stayed there during the spring and early summer of 1903, coming to London occasionally for Council Meetings of the Royal Society and other matters. Some extracts from a letter to myself (March 16th, 1903) give a good picture of him at this period: clear in mind though complaining of mental weakness, feeble in body but capable of a good deal of exertion if some unusual excitement made him forget his physical ailments. I had asked him to support the ill-fated scheme for the foundation of a central Institute of Medical Science at South Kensington in connection with the University of London; where it was proposed to concentrate all the teaching for undergraduates of intermediate subjects, such as anatomy and physiology.

"I am sorry to have been so long in replying to your letter of the 9th inst. The cause of the delay has been the state of my health, which, though it does make progress, does so very slowly; and nothing, I find, tends more to throw me back than anything like strong mental effort. And it so happens that I have had of late much correspondence on very important matters to which I have

been compelled to give my first attention. So from day to day your business has been neglected. And now at last I am afraid I must ask to be excused from complying with Dr. Fowler's request. . . . I must frankly say that the idea of dividing medical study into two entirely separate stages, to be taught at different institutions separated more or less widely from each other, seems to me an exceedingly undesirable one in itself; and however necessary it may be in the present position of the University of London, I could not gush over it and advocate it in the exceedingly warm manner adopted in the circular which Fowler enclosed. Of course I need hardly say that I wish the scheme all success that is possible, but I must ask to be excused from being its advocate. If they remove King's College Hospital to Camberwell or some other distant place, leaving King's College where it is, as some people now propose, my old school, University College, will be the only one in London where medical study can really be pursued to the best advantage.

I am very sorry to disappoint Dr. Fowler; and perhaps the best way would be to put my *regretful* refusal to the score of my weak health at present; for that is really sufficient excuse.

I propose to run up to London on Thursday to attend the reception of Chamberlain at the Guild Hall, and the lunch to him at the Mansion House on Friday; returning here on Monday. I am not sure that it is wise; but my doctor is in favour of it."

Another matter in connection with the University of London brought him up to London again in June. The Senate, which after three years had almost settled down under its new constitution, determined to make a fresh departure by conferring certain honorary degrees, as is done by other Universities. This was violently and persistently opposed by some of the graduates, who resented the addition of meaningless ornaments to what they hoped would turn out to be a severely practical University. The Senate, however, did not yield to the clamour, and selected for the honour they proposed to bestow, the Prince and Princess of Wales, Lord Kelvin, and Lord Lister.

Presentation Day 1903 thus became a memorable and historic occasion. The degrees were conferred, not, as is usually the case, in the University buildings, but in the Albert Hall, every seat in which was occupied by the gaily attired graduates and their friends. The Prince of Wales received the degree of Doctor of Laws, the Princess that of

Doctor of Music, and Lord Kelvin and Lord Lister that of Doctor of Science. Lister, it is needless to say, had a great reception from his professional brethren young and old. The Chancellor, Lord Rosebery, in his closing speech, bearing in mind the divided opinions amongst the graduates, assured them, that having once exercised their prerogative of granting honorary degrees the Senate would be strict and parsimonious in exercising it in future. "I hope with all my heart," he added, "and I believe in that opinion I voice the judgment of the Senate—I hope that this will not be an annual celebration; that it will not be the task of the University, at recurring periods, to find persons worthy to receive their honorary degree, and that it shall only be persons worthy to stand on the same plane with our doctors of to-night whom we shall ever summon to this dais to receive that degree in future."

This hope has been realized. No more honorary degrees have been conferred. The two aged Doctors of Science—the Chancellor called them "Princes of Science"—have gone to their rest, and the only two upon the roll to-day are the present occupants of the Throne.

In July Lister returned to Buxton, and whilst there, in August, he had a serious attack of illness which marked the end of his active career, though more than eight years of life remained for him: eight tedious years, not free from labour, and bringing with them their full share of sorrow. The precise nature of the illness was not determined. He thought himself that it was a very slight paralytic stroke; but it is more than doubtful if this was the case. It is certain, however, that his powers of walking were for a time much interfered with, and any mental effort was for long almost impossible.

By December he was able to write a long letter to his brother, telling of daily drives and how he was walking for half-an-hour at a time about the rooms of his lodgings; but as to the family gathering at Lyme for Christmas, which he had not missed for many years, that, he said, was absolutely out of the question.

In this letter he alludes to a project for collecting and editing all his writings—a matter which at this time caused him much anxiety. Ever since the time when he was a Professor at Edinburgh, his friends had urged him, if he could not see his way to writing a book on antiseptic surgery, at least to collect his papers into a volume convenient for reference. He would pass it off with a light remark. Once he said, with a twinkle of the eye, that, if ever he did such a thing, he would choose for its motto the words of the Psalmist, "My wounds stink and are corrupt because of my foolishness." Only once in his life had he the inclination to write a book, and he certainly never had the leisure for so laborious an undertaking. Moreover, the countless works on antiseptic surgery that had been written by others in the early days, showed that the subject was then too much in the process of evolution for satisfactory treatment; for they were already every one of them out of date. Now, if ever, was the time for Lister to take the matter in hand. But, alas, it was too late. He was much concerned at the impossibility of concentrated thought, and deeply impressed with the uncertainty of his tenure of life. Fearing therefore that he might be unable to take a share in the editing of his papers, he asked his nephew, Dr. Arthur Lister, to be responsible for collecting them and publishing them after his death. Subsequently, the matter was more fully discussed and he began to write out a series of instructions, which, however, did not extend beyond six pages of foolscap. They refer mostly to the two subjects that were then uppermost in his mind: the early physiological papers and some unpublished observations on the preparation of catgut. He found the effort of making these arrangements too much for him, and the matter was, for the time, allowed to drop. For four years he kept hoping against hope that he might be able to return to it, but each year that passed diminished the hope; and the fear that he would never be equal to the task was, consciously or unconsciously, seldom absent from his mind.

Of these years, 1904-1907, little needs to be said. Part of the time was spent in London, but the greater part in the country, at Torquay, Wadhurst, and often at Buxton,

Letters are not wanting, but they contain little of interest, except when he breaks away from family matters to speak with anxiety about the possibility of war with Russia; or rejoices over the end of the Russo-Japanese war: "I do not remember having ever had such solid abiding satisfaction at any other piece of public news"; or when, on the occasion of a visit of English doctors to Paris in May 1905, he notes that not only medical men but others "attributed some importance to the incidents of the Pasteur Jubilee; as if they might have acted in some degree as precursors of the *Entente Cordiale*."

That he was still studying English and foreign scientific literature, during his gradual though only partial convalescence, is shown by a correspondence in August and September 1906, with Dr. Peter Paterson, one of the surgeons of the Glasgow Royal Infirmary, who had described a new method of treating tuberculous affections.[1] The letters, including copies of his own, were put together in an envelope as though for possible future use. They contain acute criticisms and suggestions as to the modification of experiments. Sometimes he almost apologises for making such suggestions. For instance, he says: "But I am so much out of the scientific world at present that I cannot profess to have a good judgment on such matters," and again, "Such being the case, it seems very important to consider what are the essential points of novelty in your procedure. Before saying a few words on that question I must ask you to excuse me if I shoot wide of the mark, through ignorance and incapacity due to circumstances connected with my illness."

This was not the only correspondence of the sort in which he took part. He clearly felt some return of mental vigour; and this being the case, though he had become convinced that he could never complete the arrangement of his papers for publication after his death, it occurred to him that some less ambitious scheme might be carried out during his lifetime. As he grew older he had returned with affectionate remembrance to his early physiological work, and seemed more than ever convinced of its importance, and desirous that

[1] *Lancet*, 1906, vol. ii. p. 493.

it should be saved from the oblivion into which he thought that it had fallen. So in the early part of 1907 he again took up the project, which had long been laid aside, of republishing his Huxley lecture and distributing it widely amongst the profession at home and abroad. For this purpose he obtained the help of others in preparing lists of those to whom the lecture might with advantage be sent.

He preserved a copy of a letter to Professor White of Philadelphia, dated January 4th, 1907, which shows clearly what was in his mind. It tells how he had intended to republish the lecture in 1900, and how he had been prevented from doing so by years of illness, and had abandoned all idea of its appearing again during his lifetime. "But," he said, "it has occurred to me that, though belated, it may still have interest for some of my professional brethren; and I have decided to issue it again as it was delivered." And then, after asking for some names of the most eminent surgeons in the United States, he added, "The lecture has rather to do with physiology as bearing on surgery than with immediate surgical practice; but I hope that the facts referred to in it, which, though observed many years ago, are by no means universally known, are not unworthy of the attention of the surgeon."

However, he might well have spared himself all this trouble; for a far better way of making not only his early but his later work available for easy reference was already in process of evolution. There was a widespread feeling that his approaching eightieth birthday should be celebrated by some commemorative publication. Various schemes were discussed and discarded, but the suggestion of Dr. C. J. Martin, that all, or almost all, Lister's writings should be exhumed from the various journals and transactions in which they were interred, brought together in book form, and published with a short introduction, was enthusiastically adopted by those who had been pondering over the matter.

The plan was approved by a large representative meeting held in the theatre of the Royal College of Surgeons. A Committee of five [1] was appointed to carry out the work,

[1] Sir Hector C. Cameron, Sir W. Watson Cheyne, Rickman J. Godlee, Dr. C. J. Martin, Dr. Dawson Williams.

which was no sinecure, especially for Dr. Martin and Dr. Dawson Williams, who undertook the principal share of editing, interviewing publishers, throwing into a connected whole the 'introduction,' to which each member of the Committee contributed his quota, and last, but not least, discussing matters of detail with Lister; for he had very decided views to which due attention had to be paid.

The announcement of this scheme and all that had led up to it came to Lister as a complete surprise; it gave him real pleasure and removed an immense weight from his mind. In a letter to his brother dated February 25th, 1907, he says, "I learned some days ago that a proposal was on foot to commemorate my 80th birthday (5th of April next), with the publication of all my papers, addresses, etc. This originated without any consultation with me. Had I felt it objectionable, I could not have prevented it. But I cannot but feel that the republication will be far better done by a Committee during my lifetime than it could possibly be by *any*one after my decease." He goes on to say that he had long been feeling very uncomfortable about the heavy burden the former plan would have thrown upon his nephew, Dr. Lister, who was becoming more and more engaged with his work as a physician, and continues, "This new plan will involve full as much work on my part as my poor brain can do. But if I can do *anything*, it will be better than leaving things in the utter confusion in which they would have been left to A. H. [Dr. Lister]."

The considerable effort involved in giving advice and general supervision was more than repaid by the feeling of satisfaction that he would himself see his writings collected into a book which all might read, and have a voice in deciding what should be included, how the papers should be arranged, the size of the type, the method of reproduction of the illustrations and so forth. And if, from his own point of view, this was much better than a posthumous publication, it was still more so from the point of view of the Committee; for though the fiction was kept up with the outside world that he was ignorant of our scheme, the finished work had received in many places the final touch of the master's hand.

The *Collected Papers* appeared at last in June 1909,[1] in two sumptuous quarto volumes, published by the Clarendon Press, in fine bold type and with many reproductions of his drawings. The contents are arranged in five parts: (1) Physiology, (2) Pathology and Bacteriology, (3) The Antiseptic System, (4) Surgery, (5) Addresses. In each part chronological order is generally observed. Thus historical continuity is preserved, but only as regards each individual subject.

The book should not be read paper by paper, as chapters of the Bible are too often read, apart from their context; but, at all events so far as the first three sections are concerned, part by part. This is the way to realize that Lister was not a promiscuous delver in many fields, and that each investigation led to the next by natural sequence. It is true that the arrangement of the papers according to subjects makes this less apparent than it ought to be, but any other classification would have been very confusing. For such a perusal unfortunately the *Collected Papers* have one serious defect: they are too large to hold in the hand, and too costly to command a very extensive sale. Lister, with his failing eyesight, at one time thought that the print was small. But writing to me on June 11th, 1909, he said, "You have no doubt received a copy of the 'opus magnum,' my fear is that it is so magnum that there will be few who will read much of its contents." To some extent his fear was justified. They are library tomes, rarely seen on private shelves, fit companions for the classics of old days when stately folios were in fashion, and candles burned dim, and astigmatism had not been invented. One longs for a handy volume to place amongst one's most familiar authors and browse upon at leisure in an easy chair.

Lister's eightieth birthday (April 5th, 1907) was celebrated all over the world. Vienna struck the first note in the middle of March. The festival of the hundredth anniversary of the

[1] At the last moment a delay was caused by nearly the whole of the first impression being destroyed by a fire. Only a very few copies of the first impression are to be met with.

Surgical Institute was combined with a special "Lister meeting." While von Eiselsberg was speaking, a full-sized portrait of Lister was projected above the platform, and the audience of 500 rose and broke into loud applause. The Imperial Medical Association also had a festival in his honour.

This was duly reported in the British daily press, which, thus forewarned, took the matter up with enthusiasm, and on April 5th, almost every newspaper in the land had a paragraph or article, often adorned by a more or less grotesque portrait, and in many cases rather inappropriately associated with a eulogy, and a worse caricature, of Swinburne the poet, whose seventieth birthday fell on the same day.[1]

Lister was overwhelmed with letters and addresses; too many for personal acknowledgment. A steady procession of telegraph boys to Park Crescent was kept up for most of the day. There were innumerable callers, some bearing baskets of roses, till in journalistic phrase "the inner hall was lined with floral tributes."

A deputation waited on him in the morning headed by Mr. Jonathan Hutchinson,[2] which, it was stipulated, should not stay more than a quarter of an hour, lest the effort should be too much for him. In this short time Hutchinson addressed him on behalf of the Royal College of Surgeons, in the unavoidable absence of the President, and recalled their close acquaintance of over fifty years. Then Professors Tilanus of Amsterdam and Madson of Copenhagen presented addresses on behalf of their respective countries, and Lister made a brief reply.

In Berlin the German Surgical Society was in session, and the assembled surgeons united in celebrating the day. Long and flattering articles appeared in the Berlin papers. Even the *Deutsche Tageszeitung*, usually indisposed to recognize the possibility of merit outside the Fatherland, headed its article "Benefactor of Humanity," and sympathetically

[1] *The Field* had an article dealing with Lister's influence on veterinary surgery and medicine, the importance of which is not sufficiently recognized by the general public.

[2] Afterwards Sir Jonathan Hutchinson.

recalled Lister's last visit to Berlin to take part in the celebration of Virchow's eightieth birthday.

Our own medical journals did not fail to join in the hymn of praise. Perhaps the most appropriate contribution was that of the *British Medical Journal* which, on April 6th, republished Sir Hector Cameron's three lectures on the evolution of wound treatment during the last forty years.[1] These lectures were delivered in 1906, but they had been revised by Lister, who had rewritten a few passages, which, as their author said, gave the views set forth the value of his authority and approval. Above the title was a representation of the Lister bas-relief in the tympanum of the surgical pavilion of the Policlinico Umberto I. at Rome.[2]

The crowded events of the day, the messages of friendship and respect, and the world-wide recognition of the value of his work, were a source of much solemn pleasure, only alloyed by the sad consciousness that, owing to physical infirmities, he was a lonely man unable to enjoy real personal intercourse with the many friends by whom he was surrounded. Mingled with the pleasure, perhaps increasing it, was a thought to which he gave expression in writing to his brother ten days later, when the letter of congratulation from the Royal College of Surgeons was published in the *Times*: "What a change of opinion has taken place during the years in which I have been doing nothing!"

On June 28th Lister was presented with the freedom of the City of London. He had bargained for a small and very quiet gathering, but it had been arranged otherwise. As he drove down to the city that bright midsummer morning in his open carriage with Sir Richard Douglas Powell by his side as though to protect him from harm, few of his acquaintance would have recognized him. Shrunk in body, with snow white hair and a white beard, his set and care-

[1] "On the Evolution of Wound Treatment during the last Forty Years. Being the Dr. James Watson Lectures delivered at the Faculty of Physicians and Surgeons of Glasgow in Feb. 1906 by Sir Hector Cameron." Glasgow, James MacLehose and Sons, 1907.

[2] See page 513.

worn features no longer lit up by a benevolent smile, he looked like the ghost of his former self amidst the city pageant.

The council room of the Guildhall was crowded, mostly with doctors eager to have one more look at their honoured chief. He was presented to the Court of Common Council by the Worshipful Merchant Taylors' Company, of which he had been made an honorary freeman in 1903. And then the City Chamberlain, Sir Joseph Dimsdale, delivered his oration. He reminded them that Jenner had received the freedom of the city in 1803 for his researches on vaccination, which had superseded the work of Fothergill and his own distinguished relative Baron Dimsdale, who acquired renown by inoculating the Empress Catherine of Russia with smallpox. He claimed, as it were, a special title to be the medium of conveying the sentiments of London and the country to Lister because, three-quarters of a century before, his own grandfather and Lister's father, both Quakers, had been near neighbours at Upton in Essex.

But the greater part of his speech was an eloquent summary of Lister's achievements. Finally, as it were in apology for the lateness of this honour—an apology which to those whose eyes were fixed on Lister's face seemed not inappropriate—he said: "The City of London, and through her the country, places I think the coping stone this day to his monument of fame."

The elaborate gold casket containing the Freedom was then presented and, after being welcomed as a Citizen and Merchant Taylor, Lister spoke in a low voice a very few words of thanks, and so passed away finally from public view.

There remained, however, yet one more civic honour to be bestowed, which Sir Hector Cameron, the most intimate of his friends, shall describe. He had received the freedom of Edinburgh and of London. On January 22nd, 1908, he was presented with that of Glasgow. He was not able to be present, but Cameron read a letter from him to the great audience assembled, and at a banquet afterwards in the

Municipal Buildings replied to the toast of his health. In the course of his speech he said:

"He could assure them that Lord Lister was profoundly grateful for the honour which had been conferred upon him by the City of Glasgow that day. It touched a tender spot in his heart, for it carried him back to his days of youthful vigour and of action and inspiring work. John Bright once defined happiness as 'congenial occupation with a constant sense of progress.' If that be true, no man was ever happier than Lord Lister when he lived in Glasgow, for there were unfolded then before him, almost day by day, new truths of paramount importance, and these in their turn suggested the devising of new methods of treatment, which his keen scientific foresight told him would be fruitful of untold benefits to suffering humanity in all time to come. He had heard the remark made recently more than once that the honour conferred upon Lord Lister that day was a somewhat belated and tardy one, and that Glasgow should have made this recognition of his genius and of the great services he had rendered to mankind many years ago, but he assured them that whoever so thought it was not Lord Lister. Those of them who knew him well knew that he had no more striking characteristic than that modesty which was the true mark by which they could always distinguish real from spurious greatness. When great honours came upon him, as they had come in extraordinary profusion from all parts of the world during the greater part of his life, they seemed to come always with a sense, on his part, of surprise and unexpectedness. To himself it seemed that as it was in Glasgow that Lord Lister first inculcated the principles, and pursued the practice of that form of wound treatment that had renovated surgery, and by its world-wide adoption had been the means of saving countless numbers of human lives, so there was a certain dramatic completeness in the fact that Glasgow should, in the end of his career, make her contribution to that crown of honour which would in all time sit upon his brow."

CHAPTER XXXVI

CLOSING SCENES
(1908-1912)

THOSE who were admitted to Lister's sanctum in his active days were often privileged to hear long discussions of scientific problems, or to witness minute demonstrations of such experiments as were in progress. He was fond of stating a case to an attentive listener, when in the act of formulating his own ideas; but, if there happened to be only a limited amount of time at the disposal of his visitor, these admirable study-lectures might lead to a certain amount of impatience; for when once a subject was started there was no escape till the theme was exhausted. Just as, at the end of an operation, the assistant was not let off till the last bandage was secured, so, in these interviews, the argument had to be made clear even to a mind distracted by other thoughts. But, when the mind was free, they were delightful times, of which many still cherish hallowed memories; and they will not soon forget that, if his advice or help was sought, he would put aside all but the most pressing claims and give undivided attention to their needs.

After his illness in 1903 all this had changed; there were no more experiments to describe, no new speculations to discuss, and if he ever touched on scientific subjects they were mostly the well-known topics of past days. And as time went on, these and all others seemed to be overshadowed by his dread that even short visits from his nearest friends would be followed by exhaustion. Friendly calls were therefore discouraged. It may be that too much deference was paid to his wishes in this respect, for as he mixed less with

the outside world he could not help dwelling more upon his increasing infirmities. But, though seeing so few people, he kept up a considerable correspondence; and his letters were remarkably clear, and written in a firm bold hand, comparing favourably with the hurried scrawl of his younger days.

In his comparative solitude he was not idle. The final destination of his manuscripts and medals and other treasures of scientific or historical interest gave rise to much serious thought. He was far happier—though it cost him great effort—when he made up his mind to save some brands from the burning by printing certain papers the publication of which had been put off for the arrival of the convenient season.

One of these was a letter to Dr. White of Philadelphia, dated September 1895, on the treatment of fracture of the patella of long standing. He sent it to the medical papers in 1908.[1] It was written shortly after he retired from active practice, with all the acuteness and freshness that characterized that time of his life; but, in print, it has a look of antiquity and weakness, because it was illustrated by the very crude drawings taken from what may be a copy, or possibly a rough draft, of the original letter.

In June 1908 he published an unfinished letter which he had intended in 1906 to send to Hector Cameron, who was then preparing his lectures on wound treatment. It was called "Remarks on some points in the history of Antiseptic Surgery."[2] It does no more than bring together certain isolated facts with which we are familiar.

And even later, in January 1909, only a few months before the time when any considerable mental effort became impossible, he sent a short letter to the medical journals on the subject of the catgut ligature.[3] It was a final plea for the sulpho-chromic gut, speaking strongly of its advantages and of its trustworthiness, and giving some directions as to the proper method of using it. He could hardly bear the thought that many surgeons were using silk and linen and other forms

[1] *Lancet*, 1908, vol. i. p. 1049; *Brit. Med. Journ.* 1908, vol. i. p. 849.

[2] *Lancet*, 1908, vol. i. p. 1815; *Brit. Med. Journ.* 1908, vol. i. p. 1557.

[3] *Lancet*, 1909, vol. i. p. 273; *Brit. Med. Journ.* 1909, vol. i. p. 245.

of non-absorbable ligatures, although he rather grudgingly acknowledged that the perfecting of his own methods had rendered such a practice possible and even justifiable. I was one of the sinners. He wrote to me on December 24th, 1908, asking whether I was using the sulpho-chromic gut, and I was obliged to confess that, like many of my colleagues, I was mostly using silk or linen. To this he replied :

" I rejoice that you and your colleagues get such very good results with ordinary threads, because this implies that you are working excellently antiseptically. At the same time I cannot but think that it is desirable that the thread, when it has served its purpose, should be removed as speedily as may be.

The sulpho-chromic gut has also advantages when septic conditions cannot be avoided ; as I have indicated in a short letter which I have sent to the *Lancet* and the *Journal*, to appear in the next numbers."

This was the letter referred to above. A few days later he wrote to me again : " I certainly was very greatly disappointed to learn that you do not use catgut ; because I believe it to have very important advantages." He went on to describe it and enclosed some samples, and told me where it could best be obtained.

This, probably his last letter on antiseptic surgery, or indeed on any scientific subject, was written from Walmer in Kent. He went with Miss Syme to this sleepy old Cinque Port early in July 1908, having heard of its bracing air and quiet attractions from a friend who lived there. Moreover, he had long wished to see that part of the country. The visit was intended to be a short one, but he was so delighted with the place, the wide stretch of sea only separated from the house by a narrow lawn, and the pleasant drives which he was still able to enjoy, that he stopped on and on, hopeful at first—he was always hopeful—that he would get stronger. Even when he became weaker and weaker, and months lengthened into years, his horses stood in the stables in London ready to take him home, for the thought of returning was never quite abandoned. But this was not to be. In the summer of 1909, sight and hearing became much impaired. He could no longer write or read, but he dictated many letters, mostly filled with kind enquiries about the

health and progress of the younger generation; and listened with interest to the reading aloud of books and papers, not omitting the medical journals. As the autumn came on he was almost confined to his bed. Occasionally, on fine mornings, he sat in a chair to watch the sun rising over the sea. But in time even this was given up, and the last year and more of his life was marked by the very gradual ebbing away of physical and mental power.

His brother's death, in August 1908, had been a great shock to him, for they were bound by the closest ties of brotherly affection. Of the large family, one sister now alone was left, and distance prevented them from meeting.

In the years 1910 and 1911 there are no events of general interest to chronicle. The monotonous life of the little household was relieved and cheered by the very kind attention of the Walmer doctor, Mr. White, and occasional visits from Sir R. Douglas Powell. Visits from his nephews and nieces he did not encourage. Fear of the exhaustion that he knew would follow made him deny himself a pleasure for which at times he seemed earnestly to crave. We went sometimes without warning, so that he might be spared the anxiety of anticipation. They were sad times. He looked wistfully at us and told us he had "so much to say." But, alas, he was not able to give expression to these last thoughts.

For some time before the end he was unconscious and unable to recognize his sister-in-law, who for three melancholy years had watched over him with tender care; or the nephew and niece, who, alone of his own family, were present when he almost imperceptibly passed away on the morning of February 10th, 1912.

In his room were some papers which he had taken to Walmer, characteristically hoping that he might yet have time and energy to place on record the only one of his more important studies that had not been published in its entirety. This was a research into the nature and causes of suppuration, a subject which had attracted him in his student days and had occupied his thoughts throughout his life. He was hard at work upon it in 1864-5, when the investigation was broken off because Pasteur's discoveries in part solved the problem,

and at the same time provided another of such magnitude and urgent practical importance that everything else had to give way to it. The new problem, so closely linked to the old, was, of course, that of the application of the antiseptic principle to surgery. The old one was never finished. It is better to think of Lister at the last planning the completion of this unfinished piece of work, than to dwell overmuch upon the gloomy twilight that followed upon his brilliant day.

There was a general desire that he should be buried in Westminster Abbey; and this would have been gratified if he had not left clear instructions that he should be laid to rest by the side of his wife. A public funeral service was, however, held in the Abbey, on February 16th. Probably the greater part of the large congregation that filled the transepts and almost filled the nave, was composed of members of his own profession, but there were many others, men of science, old friends, old patients, and those who only knew of him by his work. The stalls in the choir were occupied by representatives of Royal Personages, the Diplomatic Corps, Ministers of State, Civic dignitaries, and delegates from Universities and Medical and Scientific Societies both British and foreign; for many had come from the nearer continental countries to pay this last tribute to his memory. The pall-bearers were representatives of the Order of Merit, the Royal Society, the Royal College of Surgeons, the Universities of London, Edinburgh and Glasgow, King's College Hospital and the Lister Institute. The insignia of his orders rested on the coffin. In the course of the service, which was conducted by the Dean, Bishop Ryle, the choir sang Handel's beautiful anthem, the words of which, though a strange blending of texts from the Old and the New Testaments, were peculiarly applicable to the occasion.

"When the ear heard him, then it blessed him, and when the eye saw him it gave witness of him; he delivered the poor that cried, the fatherless, and him that had none to help him. Kindness, meekness and comfort were in his tongue. If there was any virtue, and if there was any praise, he thought on those things. His body is buried in peace, but his name liveth evermore."

It is almost impossible to imagine anything more impressive than a great public funeral in Westminster Abbey; and yet there was a feeling of even greater solemnity at a more simple ceremony the night before, when only a few of his nearest relatives were privileged to be present. They had accompanied the coffin from his house to the Abbey. It was then carried through dimly lighted winding passages to the small and ancient Chapel of St. Faith, where the Dean read a short service, which will always be remembered by those who heard it. This would have been more in harmony with Lister's own feelings than the great pageant of the following day, for though he never minimized the importance of his life's work, he was a man of extraordinary humility. Moreover, his upbringing, and his nature, made him dislike all funeral pomps, and he sincerely hoped that when he died there would be nothing but a reverent and loving, and, above all things, a simple ceremony.

He was once present with Hector Cameron, at the funeral of a man whose scientific views he had in his early days successfully opposed. When the long service was over, they found the hearse one mass of flowers, and other carriages filled with wreaths and crosses. There were enormous numbers of mourning coaches and a huge crowd of people looking on. As they walked back to Park Crescent, Lister said: "Well, Cameron, I hope you and all other friends who survive me, will see that no fuss of that sort is made when I depart and am no more." But, as Cameron said in a letter written shortly after Lister's death, "he had both imagination and reverence enough to know that a solemn august service like that in the Abbey was no 'fuss' in the sense in which he had used the word. I am sure, so far from offering objection to it (could he have known) he would have been grateful and pleased that such reverence should be done him."

When the Abbey service was over, a little company of his nearest friends attended the short final service at the West Hampstead Cemetery, in which vast city of the dead the simple tomb where he and Lady Lister lie may, after much search, be discovered. The coffin bore only the

ORIGINAL MODEL FOR SIR THOMAS BROCK'S MEDALLION
IN WESTMINSTER ABBEY

short inscription: Joseph Lister born April 5th. 1827, died Feb. 10. 1912.

In the north transept of Westminster Abbey there is a marble medallion which will recall his face and name as long as the Abbey stands. It is fittingly placed with four others of the most distinguished men of science of the age: Darwin, Stokes, Adams and Watt.

CHAPTER XXXVII

LISTER AS AN EXPERIMENTER; AS A SPEAKER; AS AN OPERATOR. FRIENDSHIPS

DURING the five years which have passed since the events recorded in the last chapter, Lister's name has been more prominently before the public than it was in the last five years of his life. For as the tide of war still ebbs and flows, so does the contest over the best way of dealing with sepsis in wounds inflicted on the battle-field. At one time it looked as if Lister's teaching would be discarded by military surgeons altogether. But now the newer methods, which came so much into vogue at the beginning of the war, are not quite so much belauded, and in the meantime more powerful antiseptics have been discovered and better ways of using them; and thus it seems at least possible that before peace is signed the antiseptic treatment may come into its own again.

If this be true of military surgery, yet more is it likely to be the case in civil practice. But though there may still be fighting round Lister's standard for many a year to come, in due time he will be spoken of as one of the great surgeons of the past. The issue of the battle will doubtless be, in the end, decided; but the record of it in his writings will always appeal to students of history and to those who would form a just estimate of the times in which they live.

Lister fully recognized the importance of studying the works of his distinguished predecessors. He often spoke of them with great respect: especially of Ambroise Paré and John Hunter, whose names are landmarks in the history of surgery. Paré was the father of modern surgery in the sixteenth century, Hunter of that of the eighteenth. To no

others before Lister could the title be applied unless we go back into the dark ages.

Paré he admired for his independence and originality; but especially because he refused to adopt without enquiry the fantastic doctrines taught in his day, supported as they were by the vaguest of deductive reasoning.

But Hunter was his greatest hero: Hunter, who did more to revolutionize surgery by putting it on a scientific basis than any other man before the introduction of anaesthetics and antiseptics. A proof of Sharp's engraving of the portrait of Hunter by Reynolds, which had belonged to Syme, hung in Lister's study. He set such store by it, that, when I asked to borrow it about a fortnight before he died, he said, in giving permission, "As I value it very highly I should be glad to have it returned to its place at Park Crescent as soon as you have finished with it."

His copy of Palmer's *Life of Hunter* is marked in many places by pencil notes, which show that he was studying it at least as early as 1855. They are mostly opposite passages dealing with subjects which particularly interested him, either then or afterwards, such as coagulation of the blood, inflammatory fever, the principles of bleeding and their dependence on what Hunter called continuous sympathy, the action of counter-irritants, and local diseases cured by sympathy.

He always spoke of Hunter with reverence; and yet, in many ways, no two men could have been more unlike. Hunter, when he came to London after an idle youth spent in Scotland, suddenly became a man of most extraordinary energy, devoting himself first to anatomy and physiology, and later to surgery. He also found time for other pursuits. Amongst them was the gratification of a mania for collecting everything he could lay his hands on, the outcome of which was the great Hunterian Museum of the Royal College of Surgeons, and a sale after his death of pictures and curiosities of all sorts. He was thus led to the investigation of a vast number of subjects; for he could not resist the temptation to study everything that came in his way, and, when he died, he left a record of an almost incredible number of isolated problems either completely or partly elucidated.

How different was Lister's career! Diligent from the first and distracted by no engrossing hobbies, his scientific work was linked into one complete whole. His name will always be associated with his principal achievement. It is a monument *aere perennius*. But, with the notable exception of the Hunterian Museum, it is difficult to say of any one, or even of a few, of Hunter's great performances, that they stand out in striking predominance above the rest.

In temperament, culture and manners they had even less in common. Hunter's general education was imperfect and he was no lover of books; he was short-tempered, and his language was unrefined even for the age in which he lived. He was reckless and improvident, a somewhat inconstant friend, and in his over-occupied life found no place for the contemplation of moral or religious questions. The two men, had they been contemporaries, could never have been friends. Why then did Lister admire, and even reverence Hunter?

Besides the admiration that all must feel for the brilliancy of his genius, it appears that there were two main reasons. In the first place Lister approved and himself adopted Hunter's attitude towards accepted facts and the things which he was taught. He might be described as a scientific sceptic, who took nothing for granted, whose soul rebelled against accepting any tradition, however sacred, without satisfying himself that it rested on really sufficient evidence.

Secondly, Hunter was, like Lister, essentially an inductive philosopher. Buckle, in his *History of Civilization in England*, argues that Hunter being an emigrant from Scotland, where deductive philosophy was rampant, to England, where inductive reasoning had been in the ascendant since the time of Bacon, adopted unconsciously a combination of the two methods. But this statement is not supported by a study of his life and writings. If he were upsetting an ancient dogma, or supporting a new hypothesis, or propounding a new doctrine, Hunter always fell back upon experiments to prove his points. And he stands out as one of the most skilful and most inspired of experimenters.

As an experimenter Lister also may well be called inspired; not perhaps quite to the same extent as Pasteur, but he had the same faculty of seeing, as it were by instinct, the precise experiment that was required to clear up a doubtful point; and thus he seldom wasted time in fruitless investigations. He used no complicated machines, but always the simplest apparatus, often making his own with the aid of twisted wire, glass tubes and a blow-pipe. Indeed in his laboratory there was nothing more complicated to be seen than a good balance and a microscope, and hot boxes and mysterious flasks of his own design. The shelves were simply filled with bottles of chemicals, and the drawers with large supplies of the ordinary requirements of a chemical laboratory.

It was surprising to an onlooker that he could perform delicate manipulations with such unerring certainty, for his hands were not the beautiful hands of his mother. They were square and thick and the fingers rather short. Such are often said to be clever hands. There is probably nothing in the popular belief, for it is the directing brain and the nerves that count. Be that as it may, Lister's hands served him well, not only in the laboratory, but also in the performance of operations.

The question whether Lister was a good operator has often been answered in the negative; chiefly however by two classes of surgeons: those of the old school who loved the slap-dash methods of his predecessors, and younger men who only saw him in his later years, when the lessons he had taught had been followed by complications of technique which he never adopted, and deplored as unnecessary. These younger men, who had accepted the principles of the antiseptic system as true beyond the possibility of a doubt, and who had been educated in splendid modern hospitals, were shocked by the homely simplicity of the old theatre at King's College, and even more by the absence in Lister's practice of the elaborate routine which their "aseptic" teachers told them were essential to success.

But these are not the tribunals to which the question

should be submitted. The proper judges are his students from the sixties to the eighties, and more especially those who worked with him during and after that period, and who thus could compare him as an operator both with his contemporaries and his successors. Few, if any, of these would have chosen any other surgeon to operate on themselves or their dearest friends. It was not merely because of their confidence that sepsis would be avoided; but because they knew that the operation would be performed with a minimum of danger and a thoroughness impossible to excel. If there were need for it he could operate with great rapidity, but it cannot be denied that he was usually slow, and that his punctiliousness in the arrest of haemorrhage and in the stitching of wounds was extreme. This attracted attention, because the traditions of pre-anaesthetic days, when speed was essential, lingered far too long in the lecture rooms, the examination halls, and the text books. But as the antiseptic system was perfected, the necessity for greater care made slow operating imperative, and it soon became apparent that the advantages of operating slowly far outweighed its supposed disadvantages. I helped Lister in his private practice for many years, and have no hesitation in saying that he was a good operator. He was the founder of the deliberate modern method which is now almost universally adopted, but which Lister's contemporaries sneered at as being only fit for the dissecting-room. Unfortunately we still hear of surgeons "operating by the clock," or saying that a knowledge of anatomy is useless. Their doctrine is attractive, but their influence is bad; for they are often possessed of exceptional manual dexterity, and they excite the emulation of the less gifted who on all accounts should follow Lister's example.

His hand was always steady and he was particularly successful with such delicate manipulations as are involved in plastic operations and in that for cleft palate; but he was also very skilful in the performance of larger operations, of which he himself originated a considerable number.[1]

[1] An account of these and of the new instruments devised by him will be found in the Appendix.

The universal adoption of antiseptic methods led to the opening up of the new and wide fields of abdominal, thoracic, and cerebral surgery, the cultivators of which often became, more or less, specialists. Lister was a typical general surgeon. He did not advance far into any of these special fields, and it is possible that his occasional excursions into them in his later days may have given rise to the erroneous impression amongst the specialists who attended his clinique that he was not a good operator.

His method of preparing for a private operation was characteristic. The instruments were set out in order, but before putting them into his bag, standing before them he went over each successive step, mentally or even verbally, and saw that the appropriate instrument was present. He laid it down as a rule that a surgeon should have a perfectly clear plan of campaign before beginning an operation, but that he should be prepared to change his tactics at a moment's notice. He said that a serious operation made him feel, as it made that intrepid surgeon Cheselden, "sick with anxiety," [1] but added that no such feeling interfered with his concentrating his attention on the operation when once it was begun. He preferred silence, and seldom spoke whilst he was operating, feeling as he said that "to introduce an unskilled hand into such a piece of Divine mechanism as the human body is a fearful responsibility."

Just as there were different opinions as to Lister's skill as an operator, so the verdict was not unanimous as to his manner of public speaking. It was said, for example, that Edinburgh's three greatest teachers could not talk. The author of this loose *obiter dictum* was thinking of Goodsir with his monotonous sentences and long pauses for a word—so long that he seemed at times to have lost the thread of

[1] "Rapid and dexterous as he was in the practice of surgery, Cheselden was exquisitely nervous up to the very moment when he commenced to operate. Before operating he was sick from anxiety, and as the moment approached was pale from fear. But the moment he commenced his work all fear vanished, the hand was electrified with skill and the operation was perfect."—BENJAMIN WARD RICHARDSON, *Asclepiad*, vol. iii. p. 59, 1886.

the argument; of Syme with his indifferent, almost colloquial, style; and of Lister and his stammer. Lister certainly had a slight stammer from his childhood. When he was perfectly well it was scarcely noticeable, but it became more apparent at the end of a tiring session. It was a very small impediment, and some said that it added to his eloquence. But, though so slight, it was to him a source of much annoyance and even humiliation. He said it was humiliating to feel that his thoughts were clear, but to be unable to express them clearly. He was convinced that he shared this disability with St. Paul. Writing to his father on May 21st, 1865, he said, " I have felt the benefit of our trip even more the last day or two than when thee left; and have lost the aggravated tendency to stammering, which, while it lasted, was a severe thorn in the flesh."

His voice, which was musical, was rather low and gentle in ordinary conversation. It was hardly loud enough to fill a great hall satisfactorily; but, as he spoke deliberately and clearly, in good grammatical English, and without any attempt at oratory, he could make himself heard even by very large audiences. He was at his best in the lecture theatre or in rooms of moderate size. The matter was generally of such interest that the attention of the audience did not flag, even when, as often happened, his more important addresses far exceeded the stipulated limit of time. In the clinical lectures in Edinburgh the hour passed only too quickly for the students; but in them the strain of listening was relieved by the demonstration of cases or the performance of short operations.

His manner with strangers and young people had something of old-fashioned dignity handed down to him from the days when youth and age were separated by barriers that have now been swept away. This did not prevent him from gaining the confidence and affection of little children, but, as they grew older, it inspired a certain amount of awe which was also felt by those younger men and maidens who did not know him well. Some even thought him solemn and without much sense of humour; but this would never have

been admitted by his house-surgeons and dressers or those who were brought into intimate personal contact with him. He could appreciate wit as well as any man, but it had to be even cleaner wit than much which the refined could tolerate, and quite free from a suspicion of irreverence which many good people appear to relish. Yet his own not infrequent jokes were often founded on a text of Scripture. After an operation he would say, "The Bible says 'Experience teacheth fools,' but that is no proof that it teaches me." Seldom did a ward-visit pass without some little jest either to cheer a patient or to keep the students on the alert. And in Edinburgh, where his class was recruited from all parts of the kingdom, he used to watch with interest the varying rapidity with which the reflex laugh or smile was produced amongst the Irish, English and Scotch, to place them in their proper order.

During a part of his studentship in London, when he was overwrought and overweighted with the thought of personal responsibility, he became depressed and sad, but even then, to judge by the tone of letters from his fellow students, the mirthful side of his character was not quite suppressed. By the time he reached Edinburgh he had regained his buoyant spirits, and during the whole of his married life, when away on real holidays, all trace of solemnity was cast to the winds and he was an eager participator in the amusements and merriment of his juniors. Naturally, after Lady Lister's death it was never quite the same.

From the first, he commanded the respect and attracted the enthusiastic devotion of students. At University College he was recognized as the champion of students' rights and was trusted to maintain the reputation of the School at the University. It will be remembered that the twelve dressers who had worked under him when he was Syme's house-surgeon formed the kernel of his first class in Edinburgh, and even in those early days hailed him as "the Chief"; and that, as one of the twelve said, "The general impression was that he was a great thinker, and he was treated as such by all the men." I have known many who served under him in Glasgow, Edinburgh and London, and have met

numbers of others from all parts of the world, and have been struck with the fact that men of widely different temperaments, including some whose outlook on life was by no means the same as Lister's, all speak of him not only with admiration and respect, but as if they felt that he returned the personal affection which they felt towards him, and almost as if they had had some individual share in the work which he accomplished. John Stewart, writing in 1910, describes this magnetic influence: "The difficulty will be for any man to find language to express what our Master was to us. We *knew* we were in contact with Genius. We felt we were helping in the making of History and that all things were becoming new." And again in 1912: "It is beyond my power to express the feelings of reverence and love I have for Lord Lister or to say how much his life has been to me."

He never forgot his old house-surgeons. Dr. Grasett, who had been in Toronto from 1875 to 1886, thus describes his meeting with Lister after this long interval:

"I slipped into the theatre unobserved, I thought, while he was operating. I found time had changed him a bit. His brown hair was heavily tinged with grey, spectacles were necessary for operating; but in all other respects he was unchanged. I fancied perhaps he would not remember me, but after the operation was over he washed his hands in his usual deliberate manner and looking round the seats, said: 'Where is that fellow?' smiling. He warmly shook me by the hand and made me promise to dine with him that night. After dinner was over [the others] left the table, but Lister kept me, telling me all changes and improvements that he had made, the difficulties he had overcome, since I had been with him. So keen was he in telling me all this and so interested was I in listening, that the time passed quickly away and it was eleven o'clock when we went upstairs, to find only his wife and mine in the drawing room. I think the absorbing interest of his work made him oblivious to time and place." [1]

"Many of the students of my day," says another house-surgeon, Dr. Malloch, whose name the reader may remember [2], "reading of the honours conferred upon their old teacher (late

[1] "Symposium of Papers on the late Lord Lister," *Canadian Journal of Medicine and Surgery*, May 1912. A very interesting collection of papers.

[2] See page 220.

though they were in coming) have seen the page blurred before them and, while returning thanks for the great privilege that had been theirs, must have regretted that they had not made a better use of it."

"In the Hospital Wards," said Mr. Roxburgh, the last of his Edinburgh house-surgeons, "it was not only the healing art which was taught. They were a school of gentleness and human sympathy, and we can well remember the darkening of his countenance as, with stern severity, he rebuked an unthinking student for lifting a broken leg somewhat roughly. In his clinical lectures, which were models of pure classical English, such expressions as 'this poor man,' or 'this poor woman,' were much oftener heard than 'this case.'"

The affection of his students was not diminished by the fact that he could at times be very severe. A little public reproof was in his opinion useful education for dressers; but the faults of house-surgeons were, on principle, corrected in private, unless he thought that the fault if overlooked would seriously mislead the class. Such occasions were as rare as they were solemn and painful. They obviously distressed him as much as the delinquent, as he generally explained to him afterwards. Thus they were recognized as just, and soon forgiven, but the lesson was never forgotten.

Truly then it may be said in a general way that all Lister's students were his friends.

There are closer friendships and others less intimate than these, and any picture of him would be incomplete without some mention of his many friends, in the ordinary acceptation of the word, and of the few who were on terms of greater intimacy, though it is tempting to dismiss this difficult subject with Sir Michael Foster's happy phrase at the end of a speech at Toronto: "In early life Lister belonged to a Society the members of which called all men Friends, and now in turn, because of his inestimable beneficence and service to mankind, all men the world over call him Friend."

Lister was almost worshipped by his patients, rich and poor. He was so sympathetic, so patient, so minute in his attention to their wants; and his gracious manner and thoughtful face gave such an impression of power and

resource, of mastery of the situation and preparedness for those possible emergencies which haunt the minds of nervous invalids, that when they passed from his hands they also, though in a different way from his students, felt that they were saying good-bye to a friend. Not a few of Lister's enduring friendships began in this way.

The Hospital patients' point of view is finely expressed in Henley's sonnet, "The Chief," written when he was under Lister's care in the Edinburgh Infirmary:

> "His brow spreads large and placid, and his eye
> Is deep and bright, with steady looks that still.
> Soft lines of tranquil thought his face fulfill—
> His face at once benign and proud and shy.
> If envy scout, if ignorance deny,
> His faultless patience, his unyielding will,
> Beautiful gentleness, and splendid skill,
> Innumerable gratitudes reply.
> His wise, rare smile is sweet with certainties,
> And seems in all his patients to compel
> Such love and faith as failure cannot quell.
> We hold him for another Herakles,
> Battling with custom, prejudice, disease,
> As once the son of Zeus with Death and Hell."

Of the older men with whom he was intimate in his youth and early manhood—Sharpey, Owen, Christison, Maclagan and a host of others, some of whom have been mentioned in previous chapters—three stand out above the rest: Allen Thomson, John Brown and Syme. The two first were very dear to him; but for Syme he had a truly filial affection.

Amongst the long roll of his house surgeons, Hector Cameron, his first private assistant, was perhaps best fitted by temperament to become his personal friend; and he alone, of them all, had the chance of forming an intimate friendship such as is only possible between men not too widely separated in age. It is true that they were sixteen years apart; but, when they first met, Lister was still young, and Cameron had already passed his youth when he became the trusted right hand man at that most exciting period of Lister's life, taking part in and entering fully into the spirit of the great enquiry. Moreover, upon him devolved the task of keeping the flag flying in

Glasgow when Lister went to Edinburgh; and for long, in that city, he was the only champion of the cause. It was an uninterrupted friendship, and as Lister grew older, and both were left widowers, he leaned more and more on Cameron's support and counsel.

There were of course other private assistants; amongst them John Bishop in Edinburgh, serious, middle-aged and a most devoted disciple, who did not long survive Lister's departure for London; and Watson Cheyne, who owns that he never quite got over a feeling of awe of the great man, though no one, outside the family circle, saw more of Lister during the last thirty years of his active life. He was almost the last house-surgeon in Edinburgh, and he was the first in London, and helped to bear the brunt of the early difficulties at King's. An ardent admirer of Lister as a man, and an out-and-out believer in his principles and methods, he assisted him in the care of patients, carried out for him many complicated experiments, and conducted very important bacteriological enquiries of his own, bearing on the infection of wounds. His writings have done much to familiarize the world with Lister's teaching, and his example and precept to bring it home to many generations of students.

Another and a rather romantic friendship, starting in the classroom, was that of Dr. R. Hamilton Ramsay. We first hear of him in a letter from Mrs. Lister to her sister-in-law, written from Edinburgh on March 26th, 1859. Speaking of her husband's class, she says:

"He has made acquaintance of his 'bouquet-friend,' who he finds lately attended one of his lectures, and has expressed himself greatly pleased with it, and says he intends to be one of the summer class, expressing at the same time his wish that the summer course should be given, and when Joseph said that he did not mean to undertake it unless he knew of twelve students who would attend, he (Mr. Ramsay) said, 'We must get twelve then,' or to that effect."

He was older than Lister, and gave the impression of having entered the medical profession by accident; which is to some extent true, for it was the fascination of Lister's teaching which led him to do so. But there was more than the fascination of his teaching. He followed him to Glasgow

and watched over his debut with almost a brother's anxiety. In due time he was house-surgeon, and assisted him in private practice and with his experiments. Later he became intimate with many members of Lister's family. Thus in 1862, he wrote to Lister's brother:

"MY DEAR ARTHUR,

This morning at 9 Joseph gave his first clinical lecture to a large number of students whose reception of him showed their regard for him personally and their value for his teaching. He looked so well, sun-burnt from the mountain air, looking younger and much stronger (in fact quite rustic) if not quite so intellectual-looking as the paler countenance the winter session left him at its close.

Thinking it might interest your Father and you to read even the poor notes I could take, I did what I could and enclose what is to his lecture, delivered in his earnest and winning tones, as a grinning skeleton is to some lovely gifted Sappho or intellectual face of Milton.

But perhaps you may like even this and I can do no more. It is very hurried so please excuse mistakes,—and I would be so glad if it gave any pleasure to your Father and yourself, and indeed it is not too professional to read to your Mother to whom give my affectionate respect.

In great haste to catch post,

Yours ever affectionately,

ROBERT H. RAMSAY."

Ramsay was a nephew of Lord Belhaven and thus connected with the Duke of Hamilton. He was the means of introducing Lister to a large and influential circle. Lister on his part was of great assistance to Ramsay when he at last settled down in practice at Torquay, where for many years his kindness to the poor was proverbial. His beautiful tropical garden was one of the sights of the town.

Seldom are real friendships made after the age of forty-five. Lister was fifty when he came to London. It is not therefore surprising that, though during his long residence there he had a large circle of intimate acquaintances, none of them entered into that thorough comradeship which is the essence of friendships made in youth. Naturally the closest interchange of thought and sentiment was with certain of his colleagues at King's College Hospital and some of his associates at the Royal Society.

Even less is the word 'friend' strictly applicable to those dwellers in foreign lands, however sympathetic they may be, such as Kölliker, Pasteur, Tilanus, Saxtorph, Volkmann and Lucas-Championnière. Such friendships are more of the mind than of the heart; there is an occasional meeting, a few letters pass from time to time, and that is all; they have not to stand the test of life-long personal contact through evil and good report and change of circumstance.

Amongst the life-long friends of his youth three must be mentioned particularly: Sir William Roberts, Dr. Matthews Duncan and Sir William Turner.

Of all the friendships made at University College the most congenial and the most enduring was with William Roberts, who, though three years younger, was practically his contemporary, for he was dresser when Lister was house-surgeon. In later years Lister used to recall "his alertness and brightness of manner combined with great assiduity and thoroughness in all his work." They were close allies; co-presidents of the Students' Medical Society, fellow-champions of students' rights, fellow-advocates of scientific as opposed to empirical medicine, and both loud in outspoken denunciation of all forms of quackery, even at this early stage of their careers. For thirty years they were apart, for Roberts made his reputation as a scientific physician in Manchester. But during these thirty years they often met, and Roberts went outside his own special line to carry out some very important observations on spontaneous generation, to which Lister's work had directed his attention. When he came to London in 1889, Lister was already an old inhabitant. Now that they were again neighbours, the old comradeship was renewed and continued during the ten years that preceded Roberts's death in 1899.

Roberts was a thorough Welshman, and possessed all the charm and vivacity, it might be said all the best qualities, of his race. No one could be dull in his presence. He was, moreover, an accurate observer and a first-rate experimenter, and loved the scientific side of medicine so much that his chief reason for coming to London was to escape from the trammels of a large consulting practice in Manchester. Like

Lister he was a passionate lover of nature, a good field botanist, and a fisherman, all which tastes he gratified on his charming estate in Wales.

Strange to say only one letter from Roberts seems to have been preserved. It is dated January 1st, 1893:

"MY DEAR LISTER,

Allow me just to wish you and Lady Lister—and most heartily—a happy new year.

And allow me to congratulate you on your splendid address at the Pasteur celebration last week. I am told that every word of it was heard in the remotest corners of the Hall—and that its linguistic perfection was much admired. Your name will go down to posterity indissolubly associated with that of Pasteur. Your two names make an epoch in our profession—a greater epoch in my belief than has ever before occurred in the long history of medicine. Pardon me saying all this—my heart is full!"

And then he goes on to speak of scientific matters.

Very different from Roberts was the somewhat dour Aberdonian, Matthews Duncan, Lister's senior by one year, who had already been settled in Edinburgh for four years when Lister went there in 1853.

Duncan had been assistant to Sir James Y. Simpson, and was already an extra-mural lecturer on Diseases of Women. He rapidly gained a prominent position, partly by the way in which he brought science to bear on his particular specialty, partly by his skill, but in great measure by his sterling uprightness, and because throughout his life he made it his chief aim to purify and elevate this branch of the profession.

In spite of his gruff manner he was beloved by his patients and so much respected by his younger colleagues that it was said they copied him in everything, even in the colour of his brougham, the scarlet wheels of which were afterwards as well known in London as they had been in Edinburgh. Contrary to expectation, on the death of Simpson in 1870, he was not elected as his successor, and in 1877 he accepted the tempting offer of a post at St. Bartholomew's Hospital, and came south a month or two after Lister. Thus, except for the time Lister was in Glasgow, they were fellow citizens from 1853 till Duncan's death in 1890. During all these

years there was probably no one in whose judgment and advice Lister trusted more completely.

Beneath his rough exterior there was a fund of dry wit of the choicest character, and an unbounded kindness to old and young. His success in London was even greater than in Edinburgh, and his adherents became the leading lights of gynaecology.

He was a frequent guest at Park Crescent, and it was an amusing sight to see him after dinner, surrounded by a group of admirers, maintaining, with a grave face and in the broadest Scotch, some outrageous paradox such as " there is nothing on airth to prove that quinine cures ague."

One little letter of his was preserved which suggests more than it says. It was written November 11th, 1889.

" DEAR LISTER,

Your note just received touches me in a keenly sensitive part. It is most gratifying and comforting though the assurance of continued friendship I did not need. I have not had the shadow of a doubt as to that.

I have *great* pride in your position in my profession, but that is a public matter.

Though it is private I may say that, though we never have opportunity to show it, my wife and I hold none in greater esteem and affection than you and Lady Lister.

Yours,

J. MATTHEWS DUNCAN."

After Duncan's death his brother wrote to Lister, " I think you might like to hear of my brother's death from another than the medical side: I mean the spiritual side, in which I believe you take supreme interest. . . . As he loved you and you loved him, I have thought that these details, which delight me deeply, may give you also some joy."

The third friend, Sir William Turner, was somewhat of the same type. As he lived in Edinburgh sixty-two years, he was naturally looked upon as a Scotsman ; but he was born at Lancaster. Goodsir brought him from St. Bartholomew's Hospital to act as his demonstrator in 1854, so that he went to Edinburgh only a few months after Lister. He succeeded Goodsir in the Chair of Anatomy in 1867, and became one of the first anatomists of his day. He was also keenly interested

in the affairs of the University, of which he was still the very active Principal at the time of his death in 1916. Lister and he were attracted to one another from the first. During Lister's first Edinburgh period they sometimes worked together at physiological problems, sometimes compared notes of their separate investigations, and on one occasion they wrote a paper in common.[1] During the second period their lines of study no longer touched. But they were almost equally interested in medical education and University business, which were often talked over in private by them and Matthews Duncan.

For many years after Lister came to London, Turner was Chairman of the General Medical Council, and they seldom missed seeing one another on the occasion of its meetings.

Like Matthews Duncan, Turner had rather a stern countenance. But his apparent severity was only skin deep, as even his students quickly discovered. It heightened the effect of a rich vein of humour familiar to those who knew him well, without the possession of which it is doubtful whether anyone could have become an intimate friend of Lister.

These four friends had many points in common. They were all possessed of great intellectual power and accuracy of thought and expression. Slovenliness was to them a sin: They were pure-minded, and transparently honest. To each of them quackery in all its forms was anathema. And there was one other bond not often spoken of, but well recognized, a simple, it might be said a childlike faith in the Christian religion.

Many of those who were very closely associated with Lister discovered this in his case, though, except to a few, he seldom spoke or wrote on such matters. In his youth and early manhood indeed, as was more the custom in those days, he freely discussed what are called spiritual subjects with his relations and even his more intimate students. In later life the curtain of reserve was only on rare occasions drawn aside. An old house-surgeon writes:

[1] "Some Observations on the Structure of Nerve-fibres," by Joseph Lister and William Turner, *Quarterly Journal of Microscopical Science*, 1860, vol. viii. p. 29.

" I hope that in your account of our great Master you may be able to tell the world something of his mind on the really great things : the Eternal truths. For my own part I cannot but feel that his life was, what is termed in theological language, a life of faith, even if he had never spoken a word to indicate his views.

That he believed in the Divine Father of all, that he regarded the problems of life and death with simple faith and reverence, that he had firm faith in a personal immortality, I have no doubt, and I treasure as my greatest possessions, letters in which he has given expression to such faith and hope."

This is unquestionably an accurate estimate of his position. About 1895, it was the fashion to ask distinguished scientific men to give public expression to their views on religious matters, with the object of showing that those who had probed the secrets of nature most deeply could still be devout Christians. Lister was at the time President of the Royal Society. He answered the question when it was put to him in these words, but he did not consent to their publication till 1909: " I have no hesitation in saying that in my opinion there is no antagonism between the Religion of Jesus Christ and any fact scientifically established."

APPENDIX

In the following pages are included certain matters of no interest for the general reader, but which medical men at the present day and students of the future will agree should not be omitted from a life of Lister. Some may think that the last section might have been left out, but they would not think so if they knew how strongly he held the views expressed in the two letters therein contained. If it had been possible the section on Suppuration would have been incorporated in the text, but as the subject is highly technical and the work was never completed, it has been decided to place it in the Appendix.

APPENDIX I

LISTER'S CONTRIBUTIONS TO GENERAL SURGERY

LISTER's reputation as a man of science has distracted attention from the fact that he was a great practical surgeon, and that he introduced several new operations and many modifications of old ones. Some of these are here placed together, more or less in chronological order.

AMPUTATION OF THIGH

Whilst he was teaching operative surgery in Edinburgh (1858-1860), or about that time, he devised a new amputation through the condyles of the femur, which he called a modification of Carden's amputation, though it resembles Carden's[1] operation only inasmuch as the bone is divided at the same place, and, the thick skin over the knee being made use of to cover the end of the stump, the scar is behind and well out of the way of pressure. Carden made one very long anterior skin flap. Lister's was a circular amputation with a minute posterior flap, the sole object of which was to secure a neat scar. The incision was made over the anterior tuberosity of the tibia. The femur was divided at the level of the upper border of the patella, when the knee was flexed, that is, immediately above the articular cartilage.[2]

It is, in the opinion of those who perform it, superior to any other amputation through, or in close proximity to the knee-joint; for while the stump which results is so sound that the patient's weight can be partly borne on the end of it, it is not so long that, when an artificial limb is fitted, the amputated thigh appears to be, and for practical purposes is, somewhat longer than the sound one, as is the case after amputations through the knee-joint.

[1] Henry Douglas Carden. See *British Medical Journal*, 1864, vol. i. p. 416.

[2] See *Collected Papers*, vol. ii. p. 410.

One merit of this operation is that it interferes very little with the circulation, and for this reason it is to be recommended in cases of senile and diabetic gangrene.

Excision of Wrist

His new operation for excision of the wrist joint,[1] first described in 1865, had then been under consideration for two years. At this time conservative surgery was seldom attempted in cases of tuberculous disease of the wrist.

He was encouraged to take up the subject again by pondering over a compound fracture of the wrist that had occurred in 1863. He had sawed off the ends of the radius and ulna, which had been forced out of the wound on the front of the forearm, after tearing their way roughly through the flexor tendons. He attributed the almost perfect result obtained, in great measure, to methodical passive movement begun at a very early stage.

His operation was, it must be owned, very elaborate. Two long incisions were planned with the object of avoiding important vessels, preserving the tendons, allowing the extrusion of the diseased parts for thorough inspection and complete removal, and for the provision of efficient drainage. It was devised before the introduction of Volkmann's sharp-spoon, which has made operations of this sort much more easy. A gouge, a small saw and bone pliers were the only special instruments to be had. Thus it proved to be so difficult, and so tedious to perform, that few surgeons had the patience, even if they thought it right, to carry out all Lister's minute instructions. Those who did so however were amply rewarded and many useful hands were saved, especially by those who recognized that success depended largely upon patient attention to after-treatment.

Simpler operations are now usually substituted for it, but equally good results are not more frequently, if so often, obtained.

Amputation at the Hip

He was early in the field with suggestions for a safer but less expeditious amputation at the hip joint than the old flap operation, which used to be performed at lightning speed before admiring spectators. Hector Cameron in a letter to me tells how the idea first occurred to Lister. "One of his colleagues was amputating through the trochanters for a sarcoma of the lower end of the femur in a young governess. While he was tying the vessels, Joseph Coats split up the femur and found appearances of mischief

[1] See page 117, and *Collected Papers*, vol. ii. p. 417.

well up the medullary canal. Lister advised that the bit of femur remaining should be dissected out and disarticulated and removed. Lister said to me afterwards 'I believe, Cameron, that is the way always to amputate at the hip'; and, I think, he always did. The girl recovered, but died 7 or 8 months after from tumour in the lung. That occurred in pre-antiseptic days." In some notes of his systematic lectures in 1869 he is reported to have said, "This is what I am inclined to think should always be done instead of amputating through the hip, to amputate the soft parts high up in the thigh, and then dissect out the head of the bone. We know that amputation at the hip joint is very fatal. Why should this be? Not certainly because the hip joint is opened into, but because the wound is so large. But if we operate in the thigh, dissect the bone bare, and then take it out of its socket, there is not much danger with the soft parts. But this is only a suggestion." At this time he always sawed the bone below the trochanters, then tied the vessels and afterwards disarticulated the head whilst holding the bone with lion forceps.

In the later editions of the article on Amputation, he modestly refers to the case of his colleague at Glasgow, without claiming any credit for that part of the operation which was new. He points out however that the correctness of his views had been confirmed by the practice of Mr. Furneaux Jordan, (who published an account of his well-known operation in 1879[1]), and then proceeds to describe an operation by what is commonly known as the external racket-shaped incision. The final step of dissecting out the upper part of the bone and disarticulating its head was not to be undertaken until the amputation through the soft parts was complete. One advantage, amongst others, claimed for this amputation was that the wound, being on the outer side of the limb, could easily be kept aseptic.

In order to control the bleeding he employed at first his own aortic tourniquet.[2] But later he recommended a simple modification of Esmarch's method of elastic compression of the aorta.[3]

Lister's amputation at the hip joint marked an important step in advance towards the modern operation with an anterior racket-shaped incision, which though taking still longer to perform, involves even less loss of blood, and as it is advisedly carried out with great gentleness, has almost robbed this formidable procedure of any danger.

[1] *Lancet*, 1879, vol. i. p. 405, and *Surgical Enquiries*, 2nd edition. London, J. and A. Churchill, 1880, p. 301.

[2] See page 96.

[3] *Collected Papers*, vol. ii. p. 415.

Bloodless Operating

The accuracy required for excision of the wrist and some other operations presently to be described was rendered possible by Lister's method of rendering the limbs bloodless, which he began to use either whilst he was assistant surgeon in Edinburgh or very soon after he became professor in Glasgow—that is long before the rest of the world had grasped the idea of operating bloodlessly. Esmarch's bandage, when it was introduced with all the glamour of a wonderful new German invention in 1873, was hailed with acclaim, for at that time few Englishmen knew that a better plan had been in constant use in their own country for many years.

The scientific basis of Lister's method was described in the text,[1] and the full account of it will be found in the *Collected Papers*.[2] The way in which it was carried out in practice was extremely simple. I remember the astonishment with which I first saw all the details of an operation performed on a living patient as clearly as if they were being demonstrated upon the dead body. It was on my first visit to Edinburgh about the year 1870. At University College Hospital, Petit's tourniquet was always employed. This consisted of a band of webbing which could be rapidly tightened by means of a screw arrangement. An essential part was a firm round pad, such as a roller bandage, placed beneath the screw immediately over the main artery. A space on each side of the pad escaped the constriction of the band, and thus the circulation was not completely controlled. The tourniquet was applied while the limb was horizontal, or even dependent, and the splash of blood on the tray of sawdust placed to receive it, as the limb was transfixed during an amputation, taxed the courage of young students and is never forgotten by those who heard it. In Lister's practice not a drop escaped till the tourniquet was loosened and, as he secured all the important vessels and most of the smaller ones before this was done, the loss of blood was reduced to a minimum.

He at this time used Petit's tourniquet, but without the pad. The omission of the pad insured the complete stoppage of the circulation. Before tightening the band, the limb was held up vertically for two or three minutes until it became perfectly white. The tourniquet was then screwed up with the utmost speed, and the result was as bloodless a condition as can be obtained by Esmarch's method.

It is obvious that this plan is better than that of the German surgeon in those cases where a soft tumour may be broken, or pus may be diffused amongst the tissues, by the application of

[1] See pages 99 and 429. [2] Vol. i. p. 176 *et seq.*

an elastic bandage; but, when there are no such risks, the effect is practically the same—no better and no worse. The failure of Lister's fellow countrymen to appreciate the importance of this far-reaching discovery, and to adopt it, depended no doubt on the fact that for long he took no adequate means of bringing it before the profession. He did, however, describe it in the article on Amputation as it was revised for the second edition of Holmes's *System of Surgery* published in 1871, and more fully in the third edition of this work published in 1883.[1]

Throughout his practice Lister continued to empty a limb of blood by simple elevation; he never adopted Esmarch's elastic bandage for this purpose. But he discarded the tourniquet in favour of Esmarch's indiarubber band because it was more trustworthy and more convenient.

Carcinoma of the Breast

Time passes so quickly, and surgery has changed so completely, that modern surgeons who as a matter of routine perform the most extensive operations for cancer of the breast, may find it difficult to believe that, well on in the seventies of last century, it was commonly taught, in London and elsewhere, that it was dangerous to remove the pectoral fascia and unjustifiable to clear the armpit of cancerous glands, on account of the risk of septic infection. Thus small and incomplete operations only were done. The lymphatics passing through the fascia were usually left behind, and also the axillary glands, which are almost always affected. It is small wonder that these were some of the least successful of surgical procedures, and that the almost invariable recurrence of the disease, or, it should rather be said, the continued development of the portions of growth left behind, led women to think that operations for cancer were worse than useless:—an opinion still widely held. Happily we now know that a large proportion of cases, if taken early, are permanently cured.

The first large radical operation, planned on anatomical principles, was that performed by Lister in 1867. The patient, a relation of his own, was found to have such an extensive carcinoma that no surgeon would touch it, and she was thinking of handing herself over to a quack.

Though he must often have followed the policy of despair and left poor women thus affected to their fate, yet, when the question was thus forcibly brought home to him, Lister made up his mind that the employment of antiseptics would justify a bolder course. But, as the operation was a new and dangerous one, he could not

[1] See also *Collected Papers*, vol. ii. p. 394.

possibly entrust it to another man, even if he could have found a surgeon willing to undertake it. He had accordingly the double anxiety of performing it for the first time on a member of his own family. After it was over he wrote: "The disease is, I believe, all cleared out, the armpit as well as the breast. I explored the former in my proposed manner, and found the proceeding very satisfactory, involving but slight additional wound of the skin and yet affording free access to the region." It may be added that, though he did not after all succeed in preventing decomposition in the wound, the patient recovered and lived for some years without local recurrence.

The method Lister usually adopted in after years was probably that which he worked out for this special occasion: first the breast was removed by a very long transverse incision extending from the sternum to the posterior fold of the axilla. After stopping all bleeding, a vertical incision planned to lie midway between the axillary folds was carried up from near the outer end of the first incision as far as the apex of the axilla. The edges of the two pectoral muscles were then defined, and the pectoralis major was cleaned right up to the clavicle; the edge of the latissimus dorsi was similarly defined and cleaned almost to its insertion. Both pectorals were then cut across and all the glands and fat were removed from the axilla, each vessel being isolated and divided between two ligatures. The divided muscles were then stitched together.

This is obviously the forerunner of the more extensive operations which have been introduced since that time. Lister himself modified it by removing the breast and the contents of the axilla in one mass, and in many cases by taking away parts of the pectoralis major. In this form it is still, for a large proportion of cases, a perfectly sufficient operation.

Surgery of Bladder and Urethra

Lister was much interested in diseases of the urethra and the bladder.

He introduced three improvements in the treatment of stricture. *First*, he used straight metal bougies about 6 inches in length which enabled him to deal fearlessly and efficiently with the anterior part of the canal. These bougies proved to be of great service in general surgery for the dilatation of sinuses. *Secondly*, for strictures situated further back he devised some curved metal bougies which are now often given the ridiculous name of 'Lister's sounds'. For these he did not claim the whole credit. They tapered towards the point: this was nothing new. The particular curve was that recommended by Syme; Lister's addition was

the olive-headed point; but the result of combining three good things was a far more efficient instrument for the purpose than any then in use. *Thirdly*, he anticipated by some years that form of external urethrotomy, now commonly known as Wheelhouse's operation, and first described by that surgeon in 1870.[1] Surgical operations, in their completed form, are often the product of many minds working at the same subject. This one, as shown by the following letter from Lister to his father (15 Jan. 1865), was suggested by Syme's well-known operation.

"As I know thee are always interested in my doings, I will tell thee of a case that occurred at the Infirmary the day before yesterday. It was that of a patient with extremely tight stricture of the urethra, only allowing the urine to pass in drops. When he came into the Infirmary some months ago I managed to pass an extremely small instrument through it; but since that time I could get none through it. There was a large false passage also into which instruments were very apt to pass. The stricture was pretty far back towards the bladder.

The patient being anxious to be cured, and indeed in considerable danger from his complaint, I determined to do what I had once before done in a case of retention of urine, viz. open the urethra anterior to the stricture by cutting down upon a grooved instrument passed as far as the stricture, and then, having the lips of the wound well drawn aside with hooks, *look* in, and see exactly where the stricture was seated, and try to pass a fine probe-like instrument through it. This I did very satisfactorily. Making a good free opening into the urethra before the stricture (the patient being in the lithotomy position) and having the lips of the wound well drawn aside by bent copper spatulæ, I found I could see the roof of the urethra and the place of the stricture as plainly as if I had the parts lying dissected in a plate, and at the very first attempt passed the fine director through the stricture, divided it with a knife pushed along the groove in the director, and then introduced into the bladder a full-sized catheter passed by the natural orifice. This he still retains, but will soon be able to dispense with it; and in fact the case is now reduced to that of a patient on whom Mr. Syme has performed his operation of 'external division'.

Mr. Syme has twice opened the urethra before the stricture in cases where he could not pass an instrument in the ordinary way, and then introducing his finger into the wound has succeeded, by the additional help given by the finger, in guiding an instrument through the stricture. That I *tried* in the present case, but could not succeed with, and Mr. Syme, whom I happened to see operate in both his

[1] *British Medical Journal*, 1870, vol. i. p. 125.

cases, found it very difficult. But what is new in my case is the fact that the surgeon can with perfect facility *look* into the urethra at the affected part, and then *easily* do that which otherwise would have been difficult if not impossible." This description might almost stand to-day as a description of Wheelhouse's operation.

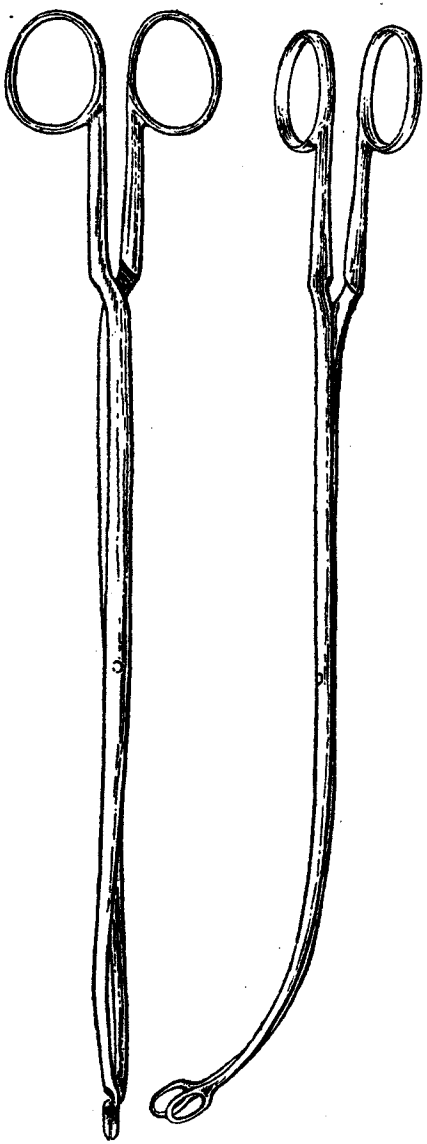
Lister was remarkably adept in the use of all urethral instruments, and especially in the manipulation of the lithotrite. He was much exercised over the question of lithotomy, and was probably the first to abandon lateral lithotomy as a routine practice in favour of the high or abdominal operation, which had almost completely fallen into disfavour. This was after his return to Edinburgh. He was prompted to this course, partly because Cheselden [1] had, for a time, obtained great success with it, but chiefly because it enabled him to perform lithotomy antiseptically, which was impossible with the lateral operation. At that time the suprapubic operation was reserved for stones too large for the lateral operation or for crushing.

It was unfortunate that Lister, trusting implicitly to the efficiency of his antiseptic precautions, determined, in his first cases, to operate through the abdominal cavity and open the bladder on the upper surface which is covered by peritoneum. His idea was that this would involve the least possible damage to the tissues, and that in a few hours, if all went well, the parts would practically have resumed their normal condition. But it so happened that more than once, as a result of severe vomiting or straining, the sutures, either of the bladder, or of the abdominal wall, gave way, with disastrous consequences. He was at first much discouraged, but when he returned to the old operation as performed by Cheselden, that is of opening the bladder on the surface not covered by peritoneum, and leaving the abdominal cavity intact, he had the same uniformly good results as are obtained at the present day. His example was quickly followed, and lateral lithotomy soon fell into disuse.

The possibility of opening the bladder antiseptically has contributed to the great advances that have taken place in vesical surgery in recent years.

For the removal of stones from the prostatic urethra he devised a long pair of forceps curved like a catheter. The shanks crossed twice, by which device, when the handles were slightly separated, that part of the instrument which occupied the bulbous part of the urethra became appreciably smaller, whilst the blades, which were fenestrated, opened widely enough to grasp such small stones

[1] William Cheselden, Anatomist and Surgeon (1688-1752). See his *Treatise on the High Operation for the Stone*, London, 1723.



URETHRAL FORCEPS.

as alone are found in the prostatic part of the canal. This was no mere surgical toy. It was an efficient instrument. Lister was justly proud of it. He specially wished me to possess the original, which in due time will be placed in the Royal College of Surgeons.

Surgery of Bones and Joints

Lister introduced many improvements in the surgery of bones and joints.

Before his day open operations for resetting badly united fractures, or for attempting to secure union in ununited fractures, or for correcting deformities, were rightly thought to be almost unjustifiable; because they were actually compound fractures inflicted by the surgeon, and exposed the patients to the fearful risks attendant upon these injuries.

When he at last honestly believed he "could operate so as to avoid putrefaction", he felt justified in dealing with a formidable case of this nature. This was in December 1868. A full account of it will be found in the *Collected Papers*[1]; which shows that it was indeed a bold, and, as it turned out, a very anxious undertaking. The patient, a fine powerful man, forty-five years of age, had fractured the neck of his femur eighteen months before. No union had taken place, and there was shortening to the extent of an inch and an eighth. It was in the early days of antiseptics. During the operation, which consisted in exposing and freshening the ends of the fragments, carbolized oil was used. The chips of bone were left in the wound, because Lister expected that they would be absorbed. The pulleys were applied to correct the shortening. A dressing of the lac plaister was then placed over the wound, and a bracketed long splint was applied. Then came one of those heart-breaking moments, when it seems as if an avenging fury were dogging the steps of the too progressive surgeon, which he thus describes. "A few hours later, my house-surgeon came to tell me that there was serious bleeding. I went at once, and found that such was indeed the case, the blood having gone through the patient's bed, and made a pool on the floor. Without disturbing the splint, I carefully removed the dressings, and proceeded to plug the wound with long strips of lint dipped in the solution of carbolic acid in oil, feeling sure that, as there had been no material bleeding at the operation, plugging would be sufficient; and as I pushed these plugs home, with my fingers dipped in the oil, and felt the mass of clotted blood, with the multitude of osseous fragments among it, I almost wondered at

[1] *Collected Papers*, vol. ii. p. 192. *British Medical Journal*, 1871, vol. ii. p. 225.

my own hardihood in making voluntarily a compound comminuted fracture of the neck of the femur." However, all went well, and he wrote thus to his father on March 21st 1869: "Thee will be glad to learn that the man who had ununited fracture of the neck of the femur is now walking on a firm limb, with only ⅛ inch of shortening, the wound having been for some time completely healed. It is, I think, the best case we have had as yet."

It was long before other surgeons ventured to follow Lister's example, and patients accordingly came to him from distant parts to have their crooked bones straightened. His method of procedure varied according to the particular bone, or part of a bone, involved. If it were the shaft of the femur,—to take an example,—after exposing the seat of fracture, he stripped off the periosteum, and then sawed the bone across, if possible in such a way as to allow of one fragment being locked into the other when the deformity had been corrected. This often necessitated a certain amount of modelling of the fragments after the first sawing, for which purpose he did not hesitate to protrude them freely out of the wound. When this part of the process was complete, the bones were drilled and bound together with very stout silver wire which was secured by twisting, and hammering-down the twisted ends.

For fixing ununited fractures of the tibia he often used iron or ivory pegs. They were not rounded and had massive square heads. They were driven obliquely into round holes made by a bradawl through both fragments, and were left projecting through the wound some distance into the dressing. The iron pegs were

removed after a certain number of weeks; those made of ivory usually became so firmly incorporated with the bone that only the distal parts could be taken away by clipping them across with bone pliers. The presence of the pegs was intended to favour the deposit of callus by exciting a mild degree of inflammation.

This way of treating ununited fractures was not so much a new departure as that of exposing and wiring badly united fractures. With badly united fractures the limbs, though deformed, were mostly useful; with ununited fractures, though possibly shapely enough, they were generally useless; thus the alternative was amputation. Moreover, experience showed that there was comparatively small risk in the open treatment of ununited fractures.

The only recent fractures he treated by operation were those of the patella and the olecranon. This subject is fully discussed

in the *Collected Papers*. To make such a new departure in surgery required great courage, because it involved the opening into healthy joints—an altogether unheard-of proceeding—which was attacked by his critics in no measured terms.

Lister had however, before his first operation on a fractured olecranon in 1873, accustomed himself to the idea of the opening of joints antiseptically. In 1868 he removed a loose cartilage from the knee joint by free incision [1]; and at least as early as 1870 he began to treat tuberculous joints by means of very free incisions: a practice which yielded remarkably good results, before the time when the partial or complete removal of the synovial membrane was introduced by König in 1884.[2] Encouraged by the safety and success of these procedures, he began to treat chronic synovitis by making a small incision and inserting a drainage tube. It was thus only one further step to open a healthy joint in order to wire a recently fractured patella or olecranon, with the object of preventing permanent lameness or restoring complete usefulness to an elbow.

Another operation of the same sort was that for curing those troublesome recurrent dislocations of the shoulder which also involved the opening of what may be considered healthy joints.

These are only a few examples of the advances in bone and joint surgery for which Lister is responsible. Thus, he was I believe the first to operate for knock-knee, for the correction of which he took out wedges of bone with the chisel and mallet.

For his larger operations in this field he often used ordinary carpenters' and sculptors' tools, rejoicing in the fine large handles which working-men know are essential for delicate manipulation. Among them were huge gouges and chisels, great heavy morticing chisels and the more delicate sculptors' tools which the hand grasps firmly and without effort. Nickel-plated all-metal instruments had hardly come into fashion. Lister preferred wooden handles. He never thought—and indeed no one pretends—that metal handles are essential to aseptic security. He used also to point out that, while the tools supplied to mechanics are often much better, they are always infinitely cheaper than those which surgeons appear to think they are obliged to put up with.

Surgery of Synovial and Serous Cavities

The antiseptic drainage of joints suggested a similar treatment for chronic effusions into other synovial and serous cavities.

[1] See page 212.

[2] *Die Tuberculose der Knochen und Gelenke*, Berlin, A. Hirschwald, 1884.

Some success was met with in the case of the bursa patellæ and other true synovial bursæ. The result of passing a large horsehair drain right through a compound ganglion of the wrist (which was not then known to be a tuberculous affection) was less satisfactory. Still less successful were the attempts to cure hydroceles by free incision and packing with some antiseptic material. For all such conditions these and all other forms of palliative treatment have long since been almost completely superseded by the radical process of excision.

In the same category must be placed his fruitless attempts to cure, by means of drainage, that almost invariably fatal congenital malformation, spina bifida. He hoped to obtain the same result as sometimes follows spontaneous rupture if the opening is very small. He believed that the small size of the orifice prevented the entrance of germs, not of course by a process of filtration but owing to the inhibitory action of the living tissues on the microbes. First he used a minute drainage tube, but the escape of fluid was too free. At last he came down to a single horse-hair, which was kept from slipping in by being fastened to a small lead button. Careful notes of these cases were made. He brought them, full of hope, before his class in 1872, but after a few days was unfortunately able to show the post-mortem appearances—for, of the few cases in which this treatment was tried, none recovered. The notes leave little doubt that sepsis was always introduced, and it is difficult to see how, with the means then at his disposal, it would have been possible to keep a dressing pure in that part of the body of a puny infant a few weeks old.

I do not know whether he himself ever treated a case of hydrocephalus in the same way. It was attempted by one at least of his immediate followers with alarming though not fatal consequences, but without effecting a cure.

Surgery of Blood Vessels

Carbolic acid being always at hand, and never absent from his thoughts, Lister used it for many purposes, in which its antiseptic properties, though useful, played only a secondary part. Thus, in the treatment of certain diseases of the vascular system, its powers of causing rapid coagulation of the blood and of exciting aseptic inflammation were utilized by endeavouring to follow what may be called Nature's methods of cure.

A well recognized treatment for varicose veins had been to inject a solution of the perchloride of iron into short lengths of the distended vessels, after attempting to isolate the parts to be so

treated by means of temporary ligatures. This was not free from risk. Sometimes the perchloride of iron passed into the general circulation through collateral branches uncontrolled by the ligatures. Sometimes it caused sloughing which led to the formation of intractable ulcers.

Lister followed a different plan. He applied a tourniquet slowly to the whole limb, thus securing distension of the veins. Then he injected a minim or two of the undiluted carbolic acid into the branches of veins it was intended to cure, and the tourniquet was not loosened until he thought time enough had elapsed for firm clotting.

In looking back it is impossible to think that there was no danger of these clots becoming displaced. But, as far as is known, no such accident occurred during the comparatively short time that this practice was followed.

For a while he treated varicocele in the same way, making use of a simple form of tourniquet which he devised for the control of the circulation.

From this he passed to the ligaturing of varicoceles with catgut, and the severing of varicose veins between two catgut ligatures. But the next step, which now seems so obvious, of making it a routine practice to remove the dilated veins bodily, did not, it appears, occur to him. This is the more to be wondered at because in 1875 he excised a mass of varicose veins mingled with blood clot as large as an orange from which bleeding had taken place. He adopted the treatment by excision as soon as it was suggested, recognizing its superiority both from the point of view of efficiency and that of safety.

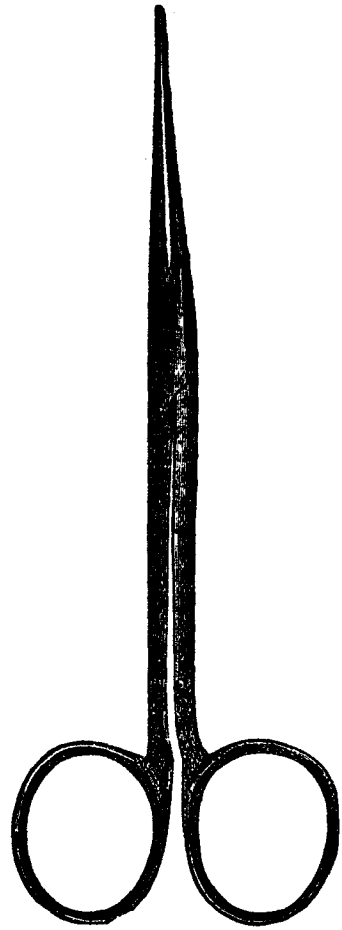
In the case of naevi, he passed two or more long pins (hare-lip pins) under the vascular mass, and produced temporary strangulation by tying a strong ligature tightly under them; or some similar contrivance was made use of for the purpose. Small quantities of undiluted carbolic acid were then injected into the nævus at various points; and after a certain length of time—usually ten minutes—the ligature was cut and the pins were removed. The intention was to obliterate some of the vessels by the immediate coagulation of their contents and to cause the ultimate obstruction of others as a result of the inflammation set up. A good deal of success was obtained. It was most striking in the case of those intractable, rapidly growing, often pulsating naevi sometimes met with in adolescents or adults involving the whole thickness of the lip or cheek or the pinna of the ear. But in the naevi of infants it was difficult to regulate the amount of the inflammation; and occasionally ugly scars resulted from the sloughing which was unintentionally caused.

He also treated internal piles in a similar fashion; but not for long; though—strange to say—this is the only one of his methods of treating vascular tumours by injecting carbolic acid, which, in modified forms, has survived to the present day.

The foregoing are the more important new operations and modifications of old ones introduced by Lister. But he made many smaller contributions to practical surgery.

Few teachers could explain so clearly the right and the wrong ways of doing an operation, and why one was right and the other wrong. Few were more punctilious with regard to the precise way in which bandages should be applied, or more exacting that all instructions in this respect should be strictly carried out. Few were more ingenious in making special apparatus from the simplest materials for the requirements of special cases.

He devised, as we have seen, many new instruments: the aortic tourniquet, the wire needle, the ear hook, the sinus forceps, the urethral bougies and the forceps for extracting stones from the prostatic urethra. But the list is by no means complete.



SINUS FORCEPS.

Moreover he knew exactly how instruments ought to be made, and would not put up with the bad copies of good instruments which are palmed off on those who do not possess this knowledge. Coarse blunt aneurism-needles, clumsy cleft-palate needles, forceps that would not bite or too strong in the spring, or chisels and gouges with the minute handles which are the delight of instrument-makers, did not find their way into his armamentarium.

Thus, though in his younger days it was said that his teaching savoured too much of physiology, and in his later years that it was overburdened with antiseptics, these complaints did not come from his students. They might perhaps think that the fundamental facts of pathology were, so to say, forced upon their attention in season and out of season; but they recognized also that the details—even the smaller details—of practical surgery were being constantly pointed out to them in a quite exceptional manner.

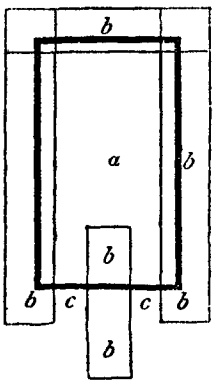
APPENDIX II

A DESCRIPTION OF LISTER'S WARDS IN 1868

THE following letter written by Marcus Beck to his friend Dr. George Vivian Poore gives an interesting account of what he saw in Glasgow in June 1868. It will be remembered that Beck was Lister's cousin, and had lived with him during the early part of his studentship. He had just completed his medical course at University College, London.

" I have seen much of carbolic acid—Lister has much softened down since the time he poured the pure acid into wounds. I have not yet seen it applied to compound fractures but I have seen it to two incised wounds—one made by removing the mamma and the other by removing a large fatty tumour ; and this was the way he treated them. The bleeding was stopped by torsion, and when it was fully arrested he mopped out the whole wound with carbolic acid dissolved in water as strong as possible which is only 1 to 20 of water I believe. The wound was then *sewed closely up* except one end which was left for the exit of discharges. Now, as Lister wisely remarks, carbolic acid cannot prevent that serous oozing you get from an incised wound for the first 24 hours, and free exit must be provided for this or its accumulation will produce sufficient tension to cause considerable irritation without any decomposition, (for you must remember the wound is sewed very closely indeed, so that the discharge cannot come out between the stitches). Then to prevent accumulation he puts in a piece of lint soaked in oil and carbolic acid (1 part acid to 10 oil). This is pulled out next morning and he has found that if removed thus early it in no way interferes with union. When it was pulled out in the breast case it was followed by a few drachms of serum stained with blood. Over the wound, when he has done, he puts a plaster of his own invention and compounded after many experiments. It is required to have some little adhesive power just to keep it adapted, but not so firmly as to shut up discharges. It is also required to hold carbolic acid made up with it. After many

experiments he found this about the best—℞, Emplast. Plumbi ℥ii, heat till it ceases to give off bubbles of watery vapour, then add yellow wax ℥ss and Litharge ℥ss and keep on heating and constantly stirring for 15 minutes. This must be done to prevent the bees-wax from getting granular as its melting point is higher than that of the Emplast. Plumbi, then add your carbolic acid to the strength required, viz., 1 to 10, 20, or 40 as the case may be. It must be done by weight of the crystals and it must be stirred in rapidly and under cover so as to lose as little of the acid by volatilization as possible. The mess is then spread on calico like strapping but it must be evenly done and $\frac{1}{8}$ inch thick. It must be kept in air-tight cases and rolled up with a piece of rag over its sticky surface soaked in oil and carbolic acid, or it would stick together. The 1 to 10 plaster is used over fresh wounds and the 1 to 40 over common dressings just to make them sweet, or as a dressing itself over a granulating sore. Then to return to our wound. After it was fully sewed up except an opening for discharges a large piece of this plaster sufficient to go at least 2 to 3 inches on each side and all round the wound is put on, and is then boxed up tight with broad pieces of strapping (half on the plaster and half on the skin) except at the most dependent part which is left open for the exit of discharges. Thus suppose this to be the plaster *a*, let *b* be the strapping, you see it is firmly boxed up everywhere except at *c*, *c*, where a place is left at the most dependent part for the exit of discharges. Then over the whole is put a folded cloth which acts 1st as a pad to keep the whole firmly adapted to the skin and 2nd as a thing to absorb the discharges. Over the whole of course is a bandage. It must be perfectly smoothly applied, great care being taken that there are no rucks or ridges in it along which air may enter. By this dressing the discharges come out as a thin layer in close contact with the 'antiseptic' plaster, and if it is properly applied any decomposition is impossible. This dressing need not be touched for 24 hours. Then for after dressings a piece of the enclosed calico is soaked in oil and carbolic acid and, as the plaster is pulled off, it is pulled on in such a manner that the wound is never exposed to the air. Then when you have got the whole thing well greased with the carbolic oil, if you want to, you may twitch this up for a minute and have a look, but this must be done very rapidly and it is better to pour on the oil freely first. You can obtain a very good view through the calico



which is almost transparent when soaked in oil and carbolic acid. Then having done this, at the first dressing you insinuate forceps under this rag and drag out the piece of oiled lint. The parts round then are just wiped clean, no water being wanted at all, and a similar plaster applied as at the dressing after the operation. The dressing has to be changed every 24 hours. At later dressings when the wound is small or over old openings of abscesses, you need not be so careful, but you may hold the oiled rag in one hand and rapidly twitch off the plaster with the other and clap on the rag immediately. In opening abscesses carbolically it is done under a flap of this oiled rag which is held up as you plunge the knife in and then dropped immediately. The knife must also be carbolicated by dipping it in the oil, and then when the pus has ceased to flow you draw off the rag, following it down with a piece of the plaster which is fitted as for a wound. I have seen no stumps or compound fractures yet treated by it, so I cannot say how they are managed.

Now the case of the breast went on as follows. She has never complained of any pain, her skin has been cool but her pulse has gone up a little on the 4th day, but never above 90. It has always been soft and nowise inflammatory. Her tongue has been a little foul but her bowels were not open. It has always been moist. Temperature has not been taken, it does not seem the go. I have been trying to persuade Lister to have it done in some cases as being a better record of absence of fever than anything else. She takes food pretty well. Locally; this has been as follows. 1st day after operation it looked as quiet as when it was done. There was copious discharge of bloody serum on the rag. It was perfectly odourless. 2nd day, much the same. 3rd day, there was some redness of the upper flap of skin. Lister supposed this to be from tension of the stitches. 4th day, on raising the rag the first 3 inches of the wound was as quiet as if it had only just been done, and I believe had united, but of course we cannot look because of the rest of the wound. Then came a little piece of the flap which had been made very thin as it was near the tumour and was now evidently going to slough, but there was no smell of any kind and the edge of the lower flap which was stitched to it (the slough) looked perfectly pale. Then came the open part of the wound which could not be brought together, and here, from the irritation of the acid was a very thin layer of pus on the surface of some granulations. 5th day (to-day), it looks just the same. The discharge on the cloth lessens every day, and consists of a little serous fluid and some slight quantity of pus (about perhaps ℥ss, or less) from the granulating sore. It has never been washed of course and yet I never smelt the least odour of any kind from it.

The wound at the operation was one of the largest I ever saw for excision of the breast. When I consider the stink there would be without the carbolic acid considering the presence of that slough and the size of the wound, I think that alone would be enough to recommend the use of the carbolic acid. I have come to no just conclusion yet, as I have seen so little of it, as to whether it hastens the cure of incised wounds very much over what might occur without it in very favourable cases, but I think it certainly is less trouble and must be safer to the patient from the absence of smell, inflammation, etc. The dressing does not take longer when you are up to it and have all things handy than water dressing, as no washing is required.

As to the case of fatty tumour; that failed, for the girl rubbed the plaster off with rolling about in the night, and next morning the discharge was slightly offensive. Lister injected the wound to try to disinfect it again but as it is a private patient I have not seen it since.

The other cases in the hospital under Lister of interest are:

1st, *a lumbar abscess* in a boy opened many months ago but which failed as decomposition set in. It was dressed in an imperfect way, since abandoned.

2nd, a case of dislocation of the foot backwards with fracture of both malleoli not diagnosed at the time by Lister's late house-surgeon and put up as a fracture. When Lister first saw it on his return to Glasgow after a trip to England firm union had taken place, but in such position as to render the foot worse than useless. He cut down and divided the callus on both sides with bone-forceps, then reduced the foot by pullies (of course opening the ankle joint) and the man has recovered with a useful foot, which is rapidly improving. There was never a drop of pus from the joint.

3rd, a knee joint out of which Lister let divers ounces of pus and which is now recovering.

4th and 5th, two men with lumbar abscesses opened by free incision. Discharge has never been over a drachm since from either, and both are fattening and the discharge very slowly diminishing I believe: but to cure them, if it is possible, will take months.

6th, a case in which two adenoid tumours were removed from the breast. No suppuration, but one cavity got filled with the discharges as Lister tried to drain both from one opening. A counter opening was made, but what came out was only bloody serum and not pus. She was two weeks from the operation before the wounds were healed.

7th, the other breast case.

8th, excision of the tongue except a very small piece, by Syme's method by sawing the jaw, etc. Recovery.

9th, excision of elbow.

10th, 11th, 12th, three Syme's amputations.

13th, a case of knee waiting for amputation.

14th, a case waiting for excision of elbow.

15th, another coming in for ditto.

16th, a very pretty painful subcutaneous tubercle in palm of hand.

17th, loose cartilages in knee.

Various hip joints which have suppurated and have been opened carbolically, children fattening and scarcely any discharge and what there is containing no pus cells.

So you see there is plenty to look at. I have made friends with Lister's house-surgeon and I find him a very nice fellow and willing to show me anything he can.

There is one thing I forgot and that is that where many sinuses exist carbolic acid is useless. Thus in excision of the elbow you usually cannot prevent decomposition for you cannot get into every sinus so as to cleanse it thoroughly, and, if one is left communicating with the inside of the wound it will act as a fresh centre for decomposition to start from. Therefore in such cases Lister either does not use it at all or else only puts it on outside to correct the smell of the discharges of pus from the wound. It is the same in many cases of amputation at the knee and ankle, and it can only be used as a palliative in cases of hip-joint in which sinuses have formed. Lister has tried injecting the sinuses with carbolic acid, but has not had much success. He did succeed in one elbow, but in another he only made it worse and had to do immediate excision yesterday as it was beginning to swell up and look ugly, and probably if he had left it till to-day it would have been too much inflamed to operate. It did not seem to be the immediate effect of the carbolic acid as it came on 3 days after the injection and was accompanied by decomposition and formation of gas inside.

There is a very good case under another surgeon. A man got a severe compound fracture at Inversnaid (where we walked to from Stronachlacher) and was brought all the way to Glasgow. The tibia stuck out about 2 inches. The house-surgeon reduced it and treated it antiseptically. Yesterday was the end of the 5th week and the dressing was removed and the wound was found to be merely a superficial sore. Of the other surgeons to the hospital, the best (Buchanan) uses the acid but the others will not do it themselves but allow their house-surgeons to do it.

I have written all this to you chiefly to while away my time as I have no books except a 10d. Shakespeare which I have been reading till my eyes ache. As I see more of carbolic acid I will write to you. I have come to this conclusion at present as far as I have seen, that it is an undoubted success. In compound fractures Lister has not exaggerated in the least; nor in his power of opening joints with safety. In psoas and lumbar abscess and in chronic abscesses connected with diseased joints and bones the abscess can be opened without any danger of prolonged suppuration following and hectic etc., and in many cases of suppuration in joints before sinuses have formed the joint may be saved when by any other means at present known it must be lost. In incised wounds, cases I believe *may* recover as quickly without it, but I believe if the average time were taken it would be immensely in favour of the carbolic acid. Of course as I have seen so little at present I can only say what my present impression is. I may have to alter as I see more, for I have to take much on the testimony of interested parties as to the history of many of the cases that are in now."

APPENDIX III

LISTER'S VIEWS ON SUPPURATION AND ESPECIALLY ON SUPPURATION OF BLOOD CLOT

It was said in the text that Lister never gave a complete account of his observations, or summed up his conclusions with regard to the process of suppuration in general and the suppuration of blood clot in particular, although these subjects were seldom absent from his thoughts and occupied much of his time from his student days to the end of his life.

When he went to Walmer in 1908 he took with him a number of notes and drawings, hoping to be able to complete a paper, begun in 1907, "On the Suppuration of Blood Clot." He had originally intended to place this amongst the *Collected Papers*; but barely two pages of foolscap were written.

Many of the notes, made at different times of his life, are difficult to decipher. They are very elaborate, but the conclusions drawn from the experiments, though seldom given, can often be gathered from references to them in his published writings.

They may be arranged in order of date.

1. A sheet of drawings made in 1851, when he was house-surgeon at University College Hospital, showing the appearance of cells found in pus taken from three cases, one of lupus, one of pyæmia and one of cystitis. Some of the cells were of large size and contained nuclei of about the size of ordinary pus cells. In those days students were simply taught that pus consisted of two parts, a fluid called liquor puris, and cells indistinguishable from the white corpuscles of the blood. Lister therefore showed these large cells to Jenner, the Professor of Pathological Anatomy—there was no Professor of Pathology at University College at that time—who offered explanations not altogether satisfactory either to himself or his pupil.

Reference is made to these drawings in the Huxley lecture. "One of the earliest records that I find of such [pathological] work is in the form of sketches of the corpuscles in the pus in a

case of pyæmia, which occurred after excision of the elbow in a little boy. The cancellated tissue of the humerus at the seat of operation and the adjacent part of the medullary cavity were seen, on post-mortem examination, to be occupied by thick, yellow pus, and similar fluid distended the brachial and axillary veins and their branches, including not only those leading from the bone towards the venous trunks, but also those proceeding from other parts of the limb, while the upper part of the axillary was plugged with a firm adhering clot. There was also suppuration in one knee-joint and multiple abscesses in the lungs. . . . I took careful camera-lucida sketches of the constituents of the pus from the various situations in which it occurred; and I also made a record of the magnifying power employed, by sketching with the camera the scale of a micrometer placed upon the stage of the microscope. And I would venture to recommend this practice strongly to pathologists. The sketch which I then made is as valuable to me to-day as if it had been made yesterday. I see from my drawing what I noted at the time, that the solid constituents of the pus were in no case pus corpuscles such as we then knew them, and I also see that they were not leucocytes. I could not explain at the time the facts that I observed, but subsequent investigation has, I believe, made them intelligible." [1]

2. Notes of two series of experiments made in Edinburgh in 1859, by passing silk threads through the cornea, and through the skin of a rabbit. Naked-eye and microscopic appearances were noted, but there is no indication of the object of this investigation.

3. Drawings and notes of experiments made in 1861 by dressing granulating surfaces with white of egg covered with gutta percha tissue, or simply with gutta percha tissue only. Suppuration always occurred, which led him to ponder over the question why, in the one case albumen, and in the other lymph was converted into pus, a change which does not occur when lymph is exuded between two layers of living tissue, say in a subcutaneous injury or effusion into a joint. He concluded that the fluids, acted upon by the air, became acrid and stimulated to suppuration by virtue of their chemical properties. One note, written on a half sheet of note paper, is of remarkable interest and must be given in full, because it shows clearly how far Lister's views had advanced with regard to suppuration, before he went to Glasgow.

" Dec. 16th, 1861.

Suppuration.

Lymph next tissue on one side and gutta-percha on the other forms pus.

[1] *Collected Papers*, vol. ii. p. 515.

Doubtless in truth the tissues form it, feeding on the lymph: because fibrine cannot develop cells if kept at 100 F. between 2 layers of gutta-percha or glass. Also albumen (white of egg) is similarly converted into a mass containing cells, if placed on a granulating surface.

What causes the action of the tissues to be so modified? viz. that instead of tissue (crude vascular fibrous) such as is found in lymph between 2 raw surfaces of living tissue, they (the tissues) form pus cells?

It cannot be the mere contact of ordinary solid matter; for glass, needles, or bullets may lie among the tissues without suppuration.

Nor can it be the absence of the influence of living tissue at one side, for the same reason: viz. a piece of glass, etc. inside the body equally prevents the tissues at one side of the lymph next it from acting on that lymph.

Therefore it seems it *must* be the influence of fluids between the gutta-percha and the tissues, for mere air does not cause any change in the action of the tissues, *e.g.* in emphysema. These fluids *being acted on by the air* are differently circumstanced from those next a bullet inside the body, which also like glass, needles, etc., not being porous afford no receptacles for lodgment of fluids so as to lead to their decomposition. Compare silk and silver-wire stitches.

How do the altered liquids act on the tissues?

Not by *merely* weakening them apparently: for pressure *e.g.* of an aneurism or tumour, though it seems to operate by *weakening* and *so* inducing absorption, does not cause suppuration.

Even in granulations, absorption without suppuration is caused by the pressure of fluid free from acridity, as seen in to-day's experiment with a sore covered 3 days ago with collodion. The crust being to-day removed, the granulations were found much excavated, but scarce any pus, chiefly slimy nearly clear pale yellowish brown liquid. And in *part* of the sore was a grey layer, quite separable, apparently a mixture of sloughing and suppurating granulations as seen by the microscope. The fluid was nearly free from any odour, though during the last 24 hours, and probably during the last 12, there had occurred some crack in the crust; and fluid had exuded.

Here the surface of the granulations had clearly been *weakened*, but scarce any suppuration had occurred.

Hence the fluids that stimulate to suppuration seem to do so by virtue of their chemical properties independently of mere weakening of the tissues (of granulations, etc.) even assuming (which is doubtful) that they do weaken them.

J. LISTER."[1]

[1] It is possible that these were notes for one of his lectures.

One can almost hear him asking himself how the air acting upon the fluids on the surface of a sore made them acrid, seeing that neither the air alone, nor the fluids alone, nor the air and fluids combined, possessed this acridity inside the body. It was the all important question to which at this time he was unable to supply the answer.

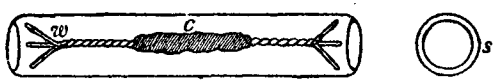
4. The next packet contains a number of drawings and notes of experiments on suppuration of blood made in Glasgow in the early part of 1864. After laying bare the jugular or saphenous vein of a horse in several places, each of the exposed parts was converted into a separate compartment by means of two ligatures,

one at the upper and one at the lower end. Into each compartment was introduced a glass tube, *a*, *b*, open at both ends, about $2\frac{3}{4}''$ long and $\frac{1}{8}''$ in diameter, *s*. In the interior of each tube was fixed a piece of fine platinum wire, *w*, round the middle of which had been tied a silk thread or a scrap of calico, *c*, in order to cause coagulation of the blood. Arrangements were made that each compartment should be full of blood before the ligature which separated it from the next compartment was tightened. The wound was closed, and after a certain number of days, it was reopened and the vein was removed, in order to examine the clots in the tubes. They were of course septic clots, for it was before the days of antiseptics.

It will be observed that the manner of performing these experiments was precisely that used in his researches at Toulouse in 1880, but the object was different, namely to see if, or it might almost be said to prove that, blood-clot does actually suppurate. In some of these experiments the glass tubes and the contained wires were exactly like those used at Toulouse.[1]

Thus he writes :—

" The tube was of the dimensions given in the sketch, *s* being a section, showing it to be thin walled. It contained a small roll



of calico, *c*, mounted upon silver wire, *w*, which was a three-fold twist with the three ends projecting tripod-like, so as to come in contact with the tube, and keep the twisted wire and calico in its

[1] See page 447. *Collected Papers*, vol. ii. p. 281.

axis, while the slight narrowing of the ends of the tube caused by smoothing them in the blow-pipe flame served to arrest the projecting portions of the wire and prevent it slipping out in either direction."

Much midnight oil was burned over the microscopical part of the investigation of the decomposing clots. At last the conclusion was reached at 4.38 a.m. on February 3rd: "There is no doubt whatever of the suppuration of blood at a part distant from any living tissue except the blood itself, and possibly germs derived from the lining membrane of the vein. But that remains to be enquired into." By "germs" he does not, of course, mean micro-organisms, but cells.

5. The next notes were made in the following month (March 1864). They are on two cases of pyæmia, one following disease of the wrist joint, the other starting five days after an amputation, for disease of the knee, which proved fatal in six days. In the first he tried to save the patient's life by amputating in the middle of the arm, but it is not stated whether this was successful. These two cases, occurring at the same time, give some indication of what was taking place in Lister's wards in 1864.

His observations were made upon the veins. He noticed that there was phlebitis, and that it was not caused by the ligature in the fatal case, because the contents of the vein at this part were healthy. He described the characteristic appearance of the clots met with in pyæmia. "On slitting open the vein at its most affected part I found that its contents were for the most part a pink fluid obviously a mixture of pus and blood and in some parts there was the yellow colour of pus; but this purulent fluid was separated from the blood in the adjoining healthy part of the vein by a very short portion of buff-coloured coagulum and from that part onwards . . . the vein seemed healthy."

In connection with the amputation of the thigh he asks himself two questions.

"Query. How does the poisonous matter get from the wound into the veins? Is it that the clot in the orifices of the cut veins suppurates, or is poisonous matter absorbed by minute veins and so carried into the venous trunk? One or other of these modes seems more probable than any other, and in the present case the latter seems the more likely. For the affection was much more marked in the trunk of the femoral vein, although its orifice was closed by ligature."

"Query. May the absence of suppuration of the clot in the vein in the immediate vicinity of the ligature have been caused by the inflammation close to the ligature, preventing the vein from

furnishing germs[1] for development? Probably not; as the separation of the various ligatures seemed going on kindly, many from smaller vessels having already dropped off.

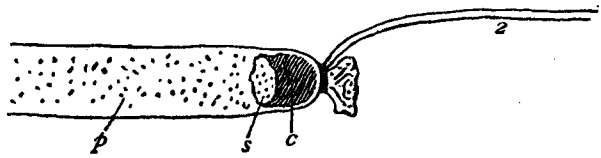


Diagram from memory of this end of the femoral vein 2 = ligatures *c* = clot, *p* = pus, *s* = small sac of pus surrounded by a very thin layer of clot."

6. In the preceding investigation he was chiefly concerned with the broad question why suppuration occurs. In the next he devoted at least equal attention to the histology of pus. These are some of the experiments referred to in his letter to his father, January 28th, 1866: "I am trying some new experiments with carbolic acid upon healing wounds and sores."[2]

They were conducted in August, 1865, and had two objects in view. *First*, a comparison of the amount and character of the pus formed on a superficial sore when it is dressed by oily or aqueous solutions of carbolic acid of different strengths, with the amount and character of the pus formed when a simple septic water dressing is applied. *Secondly*, a further attempt to solve the question of the origin and microscopical structure of pus cells.

The notes are headed "Suppuration in Man." They were made on three patients.

The first are of extraordinary interest because they are the original record of the case of James Greenlees, who was James G.:—case 1 of compound fracture in Lister's first paper on Antiseptics.[3] The side headings which may of course have been added at a later date deserve attention:—"An open sore of 9 days without suppuration under carbolic acid" and "Pellucid bodies of cells in imperfect pus, preceding granulation in a wound treated with carbolic acid, and apparently aseptic."

After describing the injury which had occurred 9 days previously, and the evidence that the fracture was compound, he proceeds: "Dr. Macfee (my house surgeon) placed a piece of lint soaked in carbolic acid on the wound and covered this lightly with cotton wadding, the limb being put up in lateral paste-board splints. It was left undisturbed 4 days, when, the boy complaining of uneasiness in the limb, the upper splint was raised and the lint

[1] By germs he means cells.

[2] See page 162.

[3] *Collected Papers*, vol. ii. p. 4.

removed from the wound, where however no suppuration was seen: but there was some redness of the neighbouring skin. I dressed the wound with water with a small quantity of carbolic acid diffused through it.[1] Next day he said the limb was easy, except that the same dressing reapplied 'nipped' the sore: the redness was much diminished. The same treatment has been since continued till to-day,[2] the dressing being changed once a day: but to-day he complained of uneasiness, and on examining the sore I found that, while the redness of the surrounding skin had all gone, desquamation of the epidermis had occurred where the dressing had lain and some portion of the true skin had sloughed. Some portions of the slough of the skin had separated and adhered to the lint: and beneath, *i.e.* on the sore left, was a little slimy fluid, opaque but too white for pus. I took up a portion of this and find now on examination with the microscope that it consists of mere debris; molecules, fat globules, portions of disintegrating striped muscular fibre and amorphous particles: no cells properly speaking, at least nothing looking like fresh cells: though some bodies looking like shrivelled red blood corpuscles are to be seen. *No vibrios.*

Thus for 9 days, an open sore has existed without suppuration although a slough has separated from it."

This was evidently something quite new in Lister's experience.

In place of this watery emulsion he next dressed the sore "with olive oil containing $\frac{1}{20}$ part of carbolic acid covered with gutta-percha after being smeared with the oil, and this covered with a bit of wet lint, and this again with gutta-percha." The gutta-percha and wet lint were used in the vain attempt to prevent the escape of the carbolic acid which it will be remembered was almost insoluble in water. In two days "the sore was covered with what looked like a sort of spurious pus, too thin for pus.... The fluid was thronged with pellucid cells, with large nuclei, the cells many of them too large for pus, in fact cells like those with which I am familiar in the blood clot of the horse developing into pus." Other cells like ordinary pus cells and fibrinous matter were also seen.

The amount of carbolic acid was then doubled, 1 part to 10 of olive oil being used. Under this dressing true pus was formed.

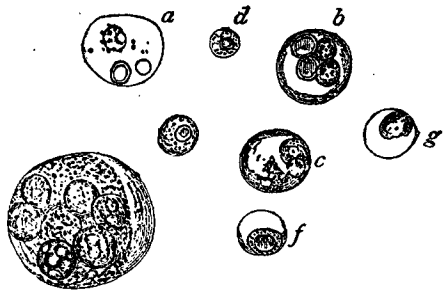
Thirteen days after the injury "Water dressing was applied to the sore, the epidermis being somewhat excoriated by the carbolic acid, and all risk of suppuration of the fracture seeming past."

[1] He says "diffused through it," because the crude carbolic acid he was working with was insoluble in water. He was therefore really applying the undiluted acid to the sore and to the surrounding skin.

[2] August 21st, 1865.

The followimg day he "found abundant liquid pus beneath the lint, the liquidity (or thinness of the liquid) as well as abundance of the discharge under the water-dressing contrasting strongly with its scantiness and thickness under carbolic acid." A few days later there was an obvious smell of decomposition, but the water dressing was continued.

He then passes on to a minute description of the microscopical appearance of the pus, of which the following may be given as an example. "In preparing the object I by accident put a small drop of the pus on a glass plate, and then a small amount of water on the covering glass which I placed on the pus, instead of as usual mixing water with the pus. This proved a good way of proceeding, as it presented the pus very little disturbed for examination. At



first sight the microscopic appearance was that of ordinary pus, but on more careful examination I saw numerous 'pellucid cells' such as *a*, *b*, *c*, the nuclei of some of these resembling some cells such as would be called ordinary pus corpuscles, for instance *d*, *f*, and *g* are 'pus corpuscles' surrounded by the bodies of the 'pellucid cells.' One large cell *e* while it had the pellucid character at one part appeared to contain numerous ordinary pus corpuscles. Lastly, I was surprised and delighted to observe, as a stream of what I supposed to be ordinary pus corpuscles passed through a narrow channel among stationary cells, each pus corpuscle was in reality the nucleus of a pellucid cell, the body of which I doubtless should not have recognised even by the help of the movement had I not been familiar with such cells through observing the suppuration of blood. Now, however, the fact was perfectly distinct. I could see with precision the limits of the bodies of the pellucid cells, as they were squeezed against one another and forced into all sorts of irregular shapes; and now and then the distinction was made doubly obvious from the circumstance of

the body of a pellucid cell containing minute granules which defined it."

On another occasion he wrote "With a view to facilitating the demonstration of the pellucid cells to others I mixed a little dry carmine powder with a drop of the pus and found that it pretty fairly answered my expectations; the carmine granules [black in figure] not entering into the pellucid bodies of the pus cells, which they thus distinguished from spaces and defined as illustrated by the sketch, *a*, in which the faint yellow colour that the nucleus (pus corpuscle) presents is also represented."

Finally he describes the removal of the splints and the complete healing of the sore, and concludes "so it may fairly be said that the result at the end of the usual time of treatment for a simple fracture was in no way affected by its being compound."

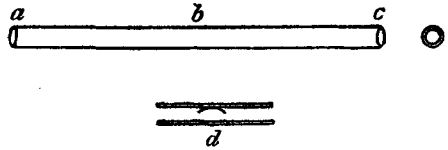
Clearly this classical case, Lister's first successful compound fracture treated antiseptically, interested him almost as much from the pathological as from the clinical point of view.

The other two cases, the notes of which are included in this packet, are much less interesting. One was that of a man with two ordinary ulcers of the leg to which various preparations of carbolic acid were applied. The other was that of a girl of fifteen who had a pressure sore on the ankle caused by a handkerchief employed to produce extension for a fractured femur. The sore was dressed with water dressings. Evidently in August, 1865, the use of carbolic acid was reserved for exceptional cases.

7. The last notes included in the packet found at Walmer bear the title "Suppuration of Horse's Blood." The observations were made between the second and the tenth of September, 1865, the last entry was made the day before Lister's second case of compound fracture treated antiseptically was admitted to the Infirmary, but he was thinking of the matter a year later, for the first sheet was copied in September, 1866, when his fifth case was causing him great anxiety.

The experiment again consisted in the introduction of pieces of tube into the veins of a living horse, and again it was not conducted antiseptically. This time the tubes were of vulcanized India rubber. About a quarter of the length of the tube from each extremity a fine piece of silk thread was attached to its inner surface, having been passed with a fine needle so as to avoid piercing the whole thickness of the wall of the tube, *d*. "The tube being introduced at first so that blood flowed from it, a piece of fine platinum wire was put firmly round it near the free

end, *a*, and then another piece of wire was put firmly round the middle of the tube, *b*, which was thus converted into two compartments, one of which was shut off from the blood in the vein while the other was open at one end, both compartments containing a bit of silk in contact with the blood in them. The tube was then pushed fully within the vein with a probe and the vein was tied both to the distal and cardiac side of the part containing the India rubber tube." Three days afterwards the piece of vein containing the tube was removed from the animal.



The object of the experiment was to see if there was any difference between the clot in that part of the tube which was in communication with the blood in the vein, and the clot in the part of the tube which was completely shut off from the blood in the vein. The hope presumably was that genuine suppuration would take place in this isolated part of the tube in spite of the fact that no living cells, such as might come from the wall of the vein, had any means of access to it.

A minute description follows of the microscopical contents of the different parts of the specimen. The vein itself contained a purulent fluid with numerous cells. The open part of the tube was filled with a dark clot in which there were a certain number of cells, and a fibroid substance beset with numerous large granular cells to some parts of which it seemed "impossible to refuse the appellation fibrous", though no distinct nucleated fibres were seen. But the closed part of the tube contained simply clot. There was an appearance of fibres, the red corpuscles were slightly altered, the liquor sanguinis somewhat tinged. There were no hæmatin crystals and "nothing that conveyed the idea of pus development." He could not be sure that there was any fœtor.

At the time when this tube had been introduced into the jugular vein of the horse another had been placed in the saphenous vein. The rest of the notes describe the contents of this piece of vein and are accompanied by a good drawing of hæmatin crystals and large nucleated cells. But the India rubber tube was nowhere to be found. It had slipped up into a further part of the vein before the distal ligature had been tightened, which accounted for the fact that there was no sign of decomposition in the contents of the vein :—a fact which had caused Lister some surprise.

The conclusions which he drew from the foregoing observations, modified and extended by the discoveries of the intervening fifteen years, were given in his address to the International Medical Congress in 1881. He was describing experiments, performed at Toulouse, which consisted in the introduction of glass tubes containing septic matter into the jugular vein of an ass. The part of the address that refers to the subject under consideration must here be given in full. "On the day after the death of the animal and removal of the vein, I continued the examination of the first compartment; and I was tearing off a part of the firm coagulum from the lining membrane when I opened into a little cavity in the clot about a quarter of an inch long and one-eighth of an inch in other dimensions, containing a thick liquid of pearly-white colour, the cavity having a thin grey lining separated by a layer of dark clot from the wall of the vein, except at one part. Here it communicated with a small venous branch, whose contents had been entirely converted into this white liquid for a short distance, beyond which the branch was obstructed by clot. On microscopic examination I found this white liquid composed entirely of closely packed corpuscles of new formation like those above described as infiltrating the clot. Here, however, the new cell development had taken place at the expense of all the original constituents of the coagulum, so that the fibrine had entirely disappeared, and only a stray red corpuscle here and there was to be discovered, and no granular debris was observed. The liquid was, in fact, neither more nor less than pus, and the cavity a small abscess. The evidence of endogenous cell development was in this liquid extremely striking. Many of the corpuscles resembled those of ordinary pus, though of varying dimensions; but often bodies exactly similar to the free pus corpuscles were seen still included as nuclei within large pellucid cells. In one such cell which I sketched there were four nuclei, three of which exactly resembled the free pus corpuscles. Thus I had the opportunity of repeating observations made in the course of very similar experiments carried out as early as 1864, experiments which, I believe, helped to prepare my mind for applying to surgical practice the conclusions of Pasteur as to the nature of putrefaction. Those observations have never yet been published, as I was compelled to suspend the investigation by the pressure of clinical work in connexion with the development of the antiseptic system. They proved, however, in the clearest manner that a blood-clot within a vein is, under septic influence, liable to a genuine suppuration—that is to say, to a change which is no mere result of breaking down of fibrine and accumulation of white corpuscles of the blood, but consists of a growth of living corpuscles multiplying by endogenous

cell development at the expense of the original constituents of the coagulum.

As to the source of these newly formed corpuscles, we must suppose them to have been derived either from the white corpuscles of the blood or from proliferation of elements of the tissues of the wall of the vein. If we conceive them to have originated in white corpuscles of the blood, it is nevertheless quite certain that they were not mere emigrated white corpuscles, but that they had sprung from them as a new and altered progeny. The actual appearances presented favoured the view that the new cells had been derived from the tissues. On examining stained sections of the wall of the vessel and the adherent coagulum, I found that the corpuscles in the latter were similar in character to those which thronged the interstices of the tissue of the inner part of the vascular wall; and among the latter were some that conveyed the idea of transition from the normal tissue elements. And this view seems confirmed by the fact that I have never succeeded in obtaining any new growth of corpuscles in coagulum outside the body, although the blood has been subjected to very various degrees of septic agency and has been kept in conditions similar to those within the body as regards temperature and moisture, and, indeed, in every respect, so far as I can judge, except only the influence of surrounding living tissues." [1]

He is here referring to observations made at different times on the changes that take place in blood outside the body. Some were as early as 1859, but most of them in the autumn of 1865, in fact at the same time as, or soon after, those which have just been described. The notes of them were preserved: [2] but they were not in the packet taken to Walmer, which may be explained by the fact that, though he sat up nearly all night over them again and again, he more than once followed a wrong scent, so that it was to some extent as he wrote in the margin, "labour thrown away."

The blood was enclosed in rubber or glass tubes; sometimes they were hermetically sealed; sometimes the ends were left open to allow of the interchange of gases; sometimes sepsis was prevented, but generally it was encouraged. His primitive hot box was "Dr. Sander's apparatus for artificial hatching of eggs." Throughout he appears to be convincing himself that the white corpuscles really do multiply and that the blood clot is beginning to be changed into pus. There is no indication that, while these particular experiments were in progress, he came to the opposite

[1] *Collected Papers*, vol. ii. p. 282.

[2] They are now at the Royal College of Surgeons, packet 30.

conclusion. It is at least possible that he continued to think, even when he owned that he had never succeeded in obtaining any new growth of corpuscles in coagulum outside the body, that if the proper conditions could be found such a growth would take place. The idea of the suppuration of blood clot—the lowest tissue of the body—always seemed to have a special fascination for him.

8. In conclusion, as it is impossible to say exactly how Lister proposed to construct his paper, a few words shall be given from the unfinished fragment. He began by mentioning the Toulouse experiments, and continued: "I referred to experiments made many years before, which as I said, 'proved in the clearest manner that a blood-clot within a vein is, under septic influence, liable to a genuine suppuration—that is to say, to a change which is no mere result of breaking down of fibrin and accumulation of white corpuscles of the blood, but consists of a growth of living corpuscles multiplying by endogenous cell development at the expense of the original constituents of the coagulum.

I have greatly regretted that the proof above referred to regarding this very important matter has never been published: and I gladly avail myself of the opportunity kindly given me of placing on record the evidence afforded by my notes and sketches.

In January 1864 I began an investigation of the pus found in the veins of the then fearfully frequent disease Pyæmia.

The opinion had been recently expressed by an eminent authority that the corpuscles seen in the fluid were an accumulation of leucocytes. Such a view seemed to me utterly inconsistent with the *post-mortem* appearances; and I resolved to submit the matter to experimental enquiry. I had been convinced several years previously, by the contrast between the invariable occurrence of inflammation and pus formation around a silk stitch retained three or four days in situ and their entire absence for an indefinite period about a suture of silver wire, that decomposition of the organic liquids was the essential cause of suppuration in wounds. And it occurred to me that by inducing putrefaction within the vein in a healthy animal, I might imitate what occurs in Pyæmia and study its nature."

After a few words leading up to an account of the experiments described under the heading No. 4, the manuscript ends abruptly.

APPENDIX IV

LISTER'S SYSTEMATIC LECTURES

WHILST Lister was Professor of Surgery in Glasgow he introduced into his systematic lectures a large amount of general physics, chemistry, anatomy and physiology. Prominence was also given to his own individual views on surgical questions, however widely they might differ from those of his contemporaries. Whenever it was possible, after 1865, he emphasized the contrast between the usual or old-fashioned treatment of wounds and the new antiseptic method. He therefore warned his class that they would not find in books all he was about to tell them, and urged them to take pretty full notes.

One excellent set of such notes has come into my hands, taken by the late Dr. William Sterling Anderson during the session 1868–9. It is intended to place copies of them in the libraries of the Royal Society of Medicine, the Royal College of Surgeons of England and the Universities of Edinburgh and Glasgow.

Of the ninety-two lectures, forty-four are devoted to inflammation and its consequences, and no less than ten of the remainder to diseases of the eye. The first part of the course is mainly founded upon, and freely illustrated from his work on the early stages of inflammation and coagulation of the blood, modified throughout by the new light that had been thrown upon both subjects by the discovery of the germ theory, the influence of which upon the treatment of inflammatory diseases is also constantly referred to. As so much time was spent on inflammation, many subjects included in the scheme of the complete course had to stand over till the following session.

A few extracts, taken almost at random from some of the earlier lectures, will help to show Lister's style of lecturing and give an idea of his frame of mind during the transition period that followed the introduction of the Antiseptic System. It is impossible to vouch for their verbal accuracy, as the notes were not taken in shorthand ; in some cases of obvious error the words of the manuscript have not been adhered to exactly.

The Germ Theory. "And now suppose you are going to change the dressing next day you will have satisfactory results if you do it properly, but if you take so much wisdom into your heads as to doubt the truth of the germ theory you will certainly have some of the failures which are recorded in the London Journals. The care which I recommend you is not very great for it can be sufficiently well learned by the nurse, but it is apparently not easily learned by doctors who must do something different from what they are told."

Abscess. In describing the antiseptic treatment of abscesses he made three statements that must have been looked upon as heretical.

1. A dependent opening is not necessary.
2. A free opening is not necessary.
3. That no harm would come from squeezing an abscess. During the preceding session he had taught the opposite commonly accepted view; now he said it was absurd to suppose that squeezing would injure the pyogenic membrane, for the pyogenic membrane was only made of granulation tissue and was not, as some thought, a gland for secreting pus.

Gangrene. He went very fully into the subject of gangrene, but said nothing about diabetes as a cause of gangrene, and apparently knew nothing about Raynaud's disease and similar vaso-motor diseases, nor about the cause of spreading gangrene.

He differed from the orthodox teaching of the day that it was essential to amputate at once in all cases of traumatic gangrene, holding as he did that if decomposition could be prevented by the integrity of the skin and the use of antiseptics the patient would be better off if amputation were postponed to a later period. But he made an exception of the case of spreading gangrene.

Speaking of senile gangrene he said:—"My belief is that when we get thoroughly satisfactory antiseptic treatment for stumps old people will be able to bear the operation which they could not do otherwise. This I only throw out as a suggestion which I hope may influence your treatment afterwards in practice. One thing you should bear in mind, that you should avoid decomposition in the mortified part by the use of some antiseptic such as carbolic acid."

Tubercle and Syphilis are both described amongst inflammatory diseases. After speaking of syphilitic ulcers, which he treated by blistering, he said: "You should never use the term syphilis in speaking to a patient. It may not be the patient's fault, for constitutional syphilis may be hereditary. Either parent may communicate the disease to their offspring. It will be well for

you to form your own opinion without asking the patient whether he has had syphilis. I, for my part, never think of asking such a question. You should be able to discern these ulcers without asking."

Struma, scrofula and tubercle were in his opinion manifestations of the same disease. He had no doubt that the tendency to tubercle was hereditary, and that hereditary syphilis might predispose to tubercle. He did not hint at the possible microbic origin of either disease. He said "I should guess that tubercle is a languid or imperfect form of inflammatory hypertrophy. The product of inflammatory hypertrophy here is imperfect but all the corpuscles are of the same nature. This is a mere speculation and not a [proved] fact."

Ligature of arteries. He described in much detail the process of separation of the old septic silk or thread ligature and the consequent danger of secondary haemorrhage, and then he continued:—"If we perform this operation under the antiseptic treatment we see that the whole subject needs to be considered again. If I have taught you correctly you will see that the cause of all the surrounding parts being changed into granulations is not because the ligature exists there as such, but that it depends upon the fact that this ligature is soaked with decomposing material."

At this time his investigations on this subject were in full swing and he often described them to his class. On one occasion he brought down the preparation of a piece of the carotid artery of a horse which he had tied with silk eight weeks before, cutting both ends of this ligature short: [1] on another we meet with these words "She I think will be the first person operated upon for aneurism of the upper part of the femoral who has recovered with absence of all constitutional symptoms." [2]

Acupressure. It is interesting to hear what he said to his students on this then burning question. "I may say, that from what I have seen and heard, I don't believe that acupressure has been proved to have the first requisite; that of being thoroughly trustworthy. Could you take an acupressure needle out of a man's thigh 48 hours after an operation and go away home with a mind at ease? I don't believe it and I don't believe it ever will be possible. . . . Altogether acupressure seems to me to be a thing of the day which will soon disappear and be forgotten entirely."

The treatment of superficial sores. Lister did not at first apply the antiseptic treatment to superficial wounds and granulating surfaces. He was driven to do so by bitter experience. In the

[1] See page 228. [2] See page 229.

early part of this course of lectures, he speaks of still using water dressings in private practice and carbolic acid in the hospital, "not for the sake of the sores themselves, but for producing as much purity as possible in the wards." But later on in the session while speaking of incised wounds he shows that he had changed his mind. "Let us consider the case of a simple incised wound but an open one. This used to be a very formidable state of affairs. They were formidable in proportion to the extent of exposed surface, much more formidable than when the edges could be brought together, for in this latter case there was a chance of union by the first intention. The result here would be that the raw surfaces would be left exposed to the influence of decomposing material. Formerly you would have put on a piece of dry lint, then water dressing for a day or two, or you would poultice till the lint had come away, and when it did so it would come with suppuration. There might be more or less inflammatory fever, a blush of redness in the surrounding skin, and the decomposing material might be absorbed into the blood. This was so dangerous that the general practice in the excision of tumours was that, if you could not take away the tumour without leaving an open wound, you were not to operate. It was very dangerous indeed. I remember a case in which I excised a small epithelial cancer from an old lady's scalp. The edges of the wound could not be brought together and the consequence was that it nearly produced death, but, by good fortune, she recovered. I determined from that very time to use an antiseptic dressing to every raw surface."

Regarding the treatment of incised wounds the edges of which can be brought together, he foresaw the theoretically perfect treatment but thought it unattainable. "But then you might say theoretically that if you have some germ poisoner which will prevent decomposition and at the same time which would not irritate the surrounding tissues, we might sew up the edges of the wound closely together. Do we know of any material which would kill the germs without irritating the tissues? If we had such a substance we might then sew up the wound and apply some antiseptic dressing and reckon upon union by the first intention. That is theoretically the correct treatment of incised wounds. Have we any such antiseptic? No!"

Compound fracture. "Fifteen cases of compound fracture were treated by my last house-surgeon Dr. Cameron and every one of these men or women are living with all their limbs on." And in another place he said that it was worse than useless to syringe out a compound fracture with carbolic acid, and not apply an antiseptic dressing. "The effect of the acid would pass away in a few hours and the parts would be exposed to a worse irritation

than if they had never been syringed with the antiseptic. Amputation at first would have been better."

The poison of Erysipelas. "The poison of the serpent acts in the same manner as the fermentation of sugar, though produced by a totally different organism. Each fermentation has its own organism. Thus the causes of putrefaction and erysipelas are not identical though frequently concomitant."

It is tempting to quote other passages, showing for example Lister's faith at this time in bleeding, even bleeding to syncope; or the almost hopeless state of abdominal surgery, it being considered worse than a forlorn hope to explore the abdomen in obscure cases of intestinal obstruction. Lister endorsed this opinion, though he mentioned a case in which he had excised a piece of gangrenous bowel and performed an immediate anastomosis, without however stating the result.

But these are enough for the purpose, if one of the *obiter dicta* be added which often fell from his lips both in the lecture theatre and the wards. He had been discussing the question of the mere pecuniary recognition of surgery, and continued:—"No man receives more gratitude than a medical man receives from his patient; no man receives more gratitude than a surgeon. No man is a greater friend of a patient than his surgeon. And a still more honourable reward than even the patient's gratitude is his own 'exceeding great reward.' No medical man when he returns from a patient, however unwilling he may have been to go and visit him, but feels that he has performed an act of beneficence. I think I never went to a patient however unwillingly without coming back with the satisfaction of having got my own great reward. And if the interest and the reward of a medical practitioner are great, much more so is it the case with the surgeon. A surgeon can see and handle the disease, and the benefit of his treatment is seen. The public can form no judgment of a physician's treatment, they have to put their faith entirely on him, and they may equally put their faith on a homoeopathist and entrust themselves to his care; but surgery is not open to this corruption." Perhaps this was not the precise word he used. It is somewhat severe; but we know Lister's life-long indignant attitude towards homœopathy. He treated it with scorn, and once swallowed a large assortment of homœopathic pilules without suffering any inconvenience.

The clinical lectures which Lister attended when a student in London, though delivered in the hospital, were not very different from systematic lectures. In Edinburgh the clinical lectures,

both medical and surgical, were more practical because they were real demonstrations given in the presence of the patients, in the former case in the wards, in the latter in the operating theatre.

Lister himself followed Syme's method which is described at page 259. He did not collect a series of patients to illustrate the varieties of one disease, or dwell specially on rare conditions. Rather he would take three or four cases that happened to be suitable for public demonstration, although the diseases from which they were suffering might be wholly unconnected with one another. Often patients were shown more than once in a session, so that the class might have the opportunity of seeing that progress was being made.

The following is a list of the subjects dealt with at four successive lectures :

December 23rd, 1872.

Simple fracture of fibula :—Pott's, with displacement backwards. Syme's splint applied.

Stricture of urethra. Instruments passed.

Bursal swelling in ham. Tapped with cannula and trochar under the spray.

January 6th, 1873.

Angular projection of spine.

Burn of back and shoulder. Boracic acid.

Disease of wrist-joint. Incisions made and pus found. This case was shown again, February 10th, and amputation performed ; also on February 20th, and on March 6th, when healing was complete.

January 9th.

Spina bifida.

Ununited fracture of humerus.

January 13th.

The same case. Amputation performed.

Malignant tumour of lower jaw. The tumour was shown on January 16th.

Fibroplastic tumour of cheek. Shown again, February 13th.

Disease of ankle-joint. Shown again, January 27th.

Sometimes he would depart from the usual course and, taking some very simple case for his text, devote the whole hour to a disquisition on a wide subject such as suppuration. Occasionally he would spend most of the time on such an important question as the treatment of stone in the bladder, and conclude with the performance of lithotomy or lithotrity.

One illustrative case may be given which was shown at several lectures in the summer of 1873. Probably the first was occupied by the operation, and the exhibition of the boy on subsequent

occasions was a useful reminder to the class that Lister was performing operations which his colleagues would have considered unjustifiable, and that this new surgery could be carried out with safety.

"May 31st 1873. This boy some time ago sustained an extremely severe compound fracture of both bones of the forearm attended with loss of substance in the forearm, and also loss of a great part of the radius. He was treated antiseptically and recovered, but the result was that the ulna was bent at an angle and the radius was ununited because the ends of the fragments did not approach each other. Accordingly an operation was called for which was performed antiseptically.

The patient having been put under chloroform and a tourniquet applied to the arm, which had been previously washed with 1 to 20 lotion, Mr. Lister, under the spray, proceeded to cut down on the ends of the radius on the outer side of the forearm and exposed them. Finding, however, that he could not get at them very well he cut down on the inner side of the forearm at a corresponding point and sawed through the ulna opposite the end of the lower fragment of the radius and then removed the ulna above that to the extent of one inch. This gave him free access to the ends of the radius, which he pared till he exposed sound bone. He then found it necessary to remove ½ inch more of the ulna. Then, having removed the tourniquet, he proceeded to secure the bleeding points about 8 in number. He then drilled the lower fragment of the radius transversely from side to side, having raised it on a copper spatula, and through the hole so made he passed a piece of strong silver wire. He then proceeded to drill a hole in the same way in the end of the upper fragment and passed through it a piece of whipcord. Exactly the same method of procedure was adopted in the case of the ulna. Then, by means of the whipcord, the wire was drawn through the upper fragment of the ulna and the two ends tied closely and firmly together. So with the radius. The wires were twisted and protruded from the wounds. Then the wounds were left freely open, covered by protective, loose gauze and a gauze dressing and bandage. Then pads of gauze were placed in the hand, over the wrist and back of the fingers, and over the condyles of the humerus, and splints padded with gauze were applied before and behind the forearm.

June 1st. Passed a good night and ate a hearty dinner to-day. No pain, redness or swelling in the arm. The ulnar wound is filled up by a clot of blood, but the radial is only slightly so and presents a concavity. The wires were found to be rather long and were snipped off. A permanent deep dressing was put on, consisting of protective and loose gauze so arranged as not to press on the

pieces of wire, and secured by a bandage. The rest of the dressing was arranged in the same way as yesterday.

June 12th. The deep dressing has not yet been disturbed but the discharge is so much diminished that we can leave the superficial dressing on for 4 days. No bad symptoms have followed the operation.

June 13th. Deep dressing removed. Limb has not been quite straight. Not much progress made. Ulnar wound very prominent and the wires completely buried. Cicatrization begun at one part. Allowed to commence to move his thumb.

July 18th. Radial wound cicatrized some time since. Ulnar wound has almost cicatrized under the boracic dressing which was next it for the last week and which has been continued. There is still mobility between the bones though now they are moderately firm."

APPENDIX V

ON THE MAKING OF POST-MORTEM EXAMINATIONS BY SURGEONS AND OBSTETRICIANS

THE following correspondence with Professor John Chiene, who at the time occupied the Chair of Clinical Surgery in Edinburgh, deals in a characteristic way with three matters on which Lister held very strong opinions:—1st, the responsibility resting upon teachers to impress upon their students the importance of the use of antiseptics in every department of practice; 2nd, the trustworthiness of properly tested antiseptics; 3rd, the disadvantage of completely divorcing pathology from clinical medicine and surgery.

Dr. H. had no doubt asked Lister to support the view that doctors engaged in midwifery practice should be forbidden to take part in post-mortem examinations.

"LAKE HOTEL, LLANGAMMARCH, BRECONSHIRE.
16 Sep. 98

MY DEAR CHIENE,

Mr. H. has written me the enclosed letter, to which I have sent the following reply.

I send also the document which accompanied his letter, in case you may not have preserved it.

'MY DEAR SIR,

I am afraid I cannot comply with your request.

I was long ago so completely satisfied of the power of an efficient antiseptic lotion to purify the hands of harmful living microbes after dissection, that when I came to London in 1877, I did not hesitate to have Mr. Godlee to assist me in private practice although he being at that time Demonstrator of Anatomy at University College, the authorities of that Institution forbade him to have anything to do with operations on the living body in the hospital during his term of office as Demonstrator. Nor have I, since my antiseptic work, ever abstained from taking part in a *post-mortem* examination, while I was in full practice as an operating

surgeon in hospital and private. And I have no reason to doubt the propriety of my action in that respect.

The experience of lying-in hospitals is exactly to the same effect. They are now much more healthy than the average of private houses for lying-in women, simply because the average medical practitioner and midwife are not yet duly impressed with the importance of the simple antiseptic precautions required. Yet these lying-in hospitals were often simply pest-houses before such precautions were used.

At the York Road Lying-in Hospital where I happen to be an honorary surgeon, there are as a rule cent-per-cent of recoveries; and if a death occurs, it is almost invariably from other than septic causes. If a case of septicæmia is taken in as such, the physician or midwife does not feel called upon to give up attendance on other patients after examining the affected one. He or she simply purifies the hands etc. antiseptically, and the case runs its course, whatever it may be, as an isolated example of the disease and does not spread to others.

The very remarkable experience of Semmelweis, which produced so strangely little impression on his contemporaries, was exactly similar. When 'Assistent' in the 1st Division of the Lying-in Department of the Vienna Hospital, he found the mortality there enormous, while it was only moderate in the 2nd division, where only midwives were taught. In the 1st division the patients were constantly examined, by way of education, by the students; and these attended also the *post mortem* examinations. Semmelweis was led to conclude that the difference in mortality in the two Divisions depended upon that fact coupled with the other fact that the pupil midwives did not attend the *post mortems*. He instituted the practice that no lying-in woman might be examined, except after washing of the examining hands with solution of chloride of lime. The result was an immediate drop of the mortality to much below that of the 2nd Division; although the students continued their educational examinations as before, except for the new regulations. This result was not merely temporary, but continued during Semmelweis's tenure of office; and similar results were got by the very few heads of lying-in hospitals who followed his example. *Now* people in Germany are glorifying his memory abundantly and most deservedly.

You will therefore understand that I cannot adopt your 'major ground'; and therefore I need not discuss your 'minor point.' But I cannot help feeling that the compulsory employment of a pathological expert, rather than the medical attendant who has been familiar with the features of the case during life, might prove by no means of unmixed advantage.

I will not argue this point, as you say that, except for the major one, you would not come forward.

I am quite sure you would wish me to say frankly what I think, and so will not apologise, but beg you to

Believe me,

Yours very sincerely,

LISTER."

"I do not know who Mr. H. is. His name does not appear in the Blue Book, and it seems to me just possible that you may have encouraged him to write to you in a moment of good nature. I feel some sympathy with the expression of the coroner; or rather I am jealous of any needless lowering of the standard of professional competence of all registered practitioners in favour of specialists.

The principle of calling in the aid of a specialist in special cases is of course already acted on in cases of poisoning, when portions of organs are sent to a chemist for analysis. Bacteriological examinations are also made for practitioners (as at our British Institute of Preventive Medicine). Except in such cases it must be very rare for a *properly educated* medical man to have any doubt as to the appearances indicating criminality in any quarter; and the means now available for preserving portions of tissue etc. would commonly allow a man to send a sample to a Special Pathologist if he needed such help.

I *suspect* our friend is *not* well educated and so does not like a *post mortem*.

Yours ever most truly,

LISTER."

To this Professor Chiene replied.

"26 CHARLOTTE SQUARE, EDINBURGH.

MY DEAR LORD LISTER,

Dr. H. is a Licentiate of the College of Surgeons in Edinburgh, and I certainly encouraged him to send a letter which I might bring before the Council of the College in October. I thought the coroner had misunderstood him.

I think there is a danger, because many are not as careful as they should be in purification—my experience in the Hospital. I also think the work would be better done. I certainly have no desire to drive work into the hands of specialists, but in the larger towns I think that these cases would be best done by pathologists.

I return memorial and H.'s letter, and if you will allow me I will send your letter to the Council with whom it will have the greatest weight and probably the whole movement, as far as the Edinburgh College is concerned, stopped.

I hope to see you on 5th October in London and also in Liverpool on the following Saturday.

I thank you for the trouble you have taken about the *Post Mortem* question.

I have been much struck by the greater success I have in private as compared with Hospital work. I have always believed that this is in some way connected with the students, on whom I have never laid any restrictions but always thorough purification of hands on coming into hospital."

Lister wrote again on September 21st, 1898.

"My dear Chiene,

I am much obliged to you for your letter.

If the 'average man' cannot be trusted, when he has been educated at a school like yours, to purify his hands after making a *post mortem*, in what, I am inclined to ask, *can* he be trusted? For my part I never found any difficulty in getting my Dressers to purify their hands. But it is one thing for a man (and he only a student) to be deficient in care in dressing cases, and quite another thing for a man who professes to be duly qualified to so grossly fail in his duty as to omit to clean his hands antiseptically after a *post mortem*. Really such conduct, if known to have led to a patient's death from puerperal fever, would deserve to be treated as manslaughter in a court of Justice; unless indeed the practitioner could plead that, at the school where he was educated, such purification was not taught to be a matter of importance!

You must excuse what you may perhaps call my intemperate zeal. But I believe the day will come (though I am not likely to live to see it) when any man or midwife who neglects strict antiseptic precautions in midwifery will be considered in the law-courts to be guilty of culpable malpraxis, if not of homicide when death results.

If you think good might come from letting your Council see my letter to H., I have no objection whatever to your doing so.

It is extremely good of you to take so much trouble in attending distant public functions as the representative of your College.

The Liverpool people are making far more of the opening of their new laboratories than I at all anticipated when I agreed to take part in the proceedings.

With my kind regards to Mrs. Chiene,

I remain,

ever truly yours,

Lister."

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